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SOLUTIONS FOR PROBLEMS OF VISUALLY IMPAIRED USERS OF RAIL RAPID TRANSIT

VOLUME I OF II

CONCERNING

IMPROVING COMMUNICATIONS WITH THE VISUALLY IMPAIRED IN RAIL RAPID TRANSIT SYSTEMS

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16. Abstract

This report describes the results of a project to study improved communications with the visually impaired in rail rapid transit systems. The purpose of the study was to analyze the problems visually impaired persons encounter as they attempt to utilize rapid rail, to identify strategies for remediating these problems, and to suggest methods for communicating with the visually impaired.

Results of the study are presented in the following areas: 1)background information about visually impaired persons; 2)problems in accessibility to rail rapid transit systems by the visually handicapped; 3)suggested methods for improving communications with the visually impaired in rail rapid transit; 4)estimated reactions to the implementation of solutions.

The suggested methods for improving communications fall within the following categories: 1)signage and other print information; 2)graphic information; 3)auditory information; 4)textural information; 5)special equipment designs; 6)architectural designs; and 7)operating procedures. Suggestions from these categories are presented according to a sequential "trip" format, in which a hypothetical route from system entrance to system exit is traced.

This document represents Volume I of a 2-volume report. The other volume is entitled (Volume II) "Information about Visual Impairment for Architects and Transit Planners." Excerpts have been taken from the Final Report and placed in a third, 30-page volume containing only the techniques suggested by the authors, without background material. This latter volume is available at the UMTA Office of Research and Technical Assistance.

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The members of the Project Advisory Committee and the Liaison Network of experts in transit and blindness are listed in the Appendix, and special thanks are given to those members who attended the national meeting to discuss the problems and solutions in May, 1981, and to the many who carefully reviewed documents and submitted comments.

Finally, we wish to express special thanks to the more than 100 visually impaired persons who contributed their time and efforts to the Project Advisory Committee, the on-site field studies of problems, and the surveys of problems and solutions.

EXECUTIVE SUMMARY

This report presents the investigative procedures, results, and recommendations generated in a systematic study of the problems which visually impaired people encounter when attempting to use rail rapid transit. The work was conducted by three principal investigators at Boston College, through contract with the Office of Policy Research, Urban Mass Transportation Administration.

The overall purpose of the study was: 1) to analyze the problems experienced by visually impaired users of rail rapid transit; 2) to identify strategies for remediating these problems, and 3) to suggest methods which would improve communication with these riders.

In order to identify and analyze the problems encountered by visually impaired users of rapid rail, the investigators employed five major procedures:

1) A detailed task analysis of a trip through a rapid rail system was done by an experienced Orientation and Mobility Teacher. This resulted in a sequential list of decisions which must be made by visually impaired travellers in rapid rail facilities. (These decision points all represented potential problems.)

2) A thorough search for, and reading of documents pertinent to the use of rapid rail transit by the visually impaired was accomplished.

3) Three Orientation and Mobility (O&M) Specialists (1 in Atlanta, 1 in Philadelphia, and 1 in Boston) travelled through their local rapid rail systems with 9 blind travellers on an independent basis (total trips = 27). The purpose of these individual trips was to gather first-hand anecdotal records of the problems encountered by each traveller. In order to maintain consistency across travellers, the O&M Specialists followed a script which had been prepared for them, and tape recorded the entire trip.

4) Based on the results of the 27 trips, the literature search, and the task analysis, an interview instrument was designed for use in telephone interviews of a stratified sample of 81 blind subjects. The purpose of these interviews was to gather additional anecdotal data as well as to verify or reinterpret problems already identified.

5) Individual interviews were conducted with 8 O&M Specialists who were familiar with the problems encountered by naive blind travellers in rapid rail systems. These interviews served to further confirm or expand upon the collection of problems which had already been identified.

Approximately 60 problems experienced by visually impaired users of rail rapid transit were identified using these procedures. The problems which were identified were then grouped in a "trip" format, as shown by the following examples:

Requirement: The user must identify the station and locate the entrance.

Problem: There was a lack of consistent signage or architectural clues which could be used to find the entrances of some stations.

Requirement: User must perceive and understand information about the correct platform, train, and direction.

Problem: Some signs were written in small print only. Some signs were poorly lit.

Requirement: User must be able to pass through doors.

Problem: Doors which opened outward and were in the path of travel were dangerous obstacles which could be walked into.

Requirement: The user must identify the desired stop or station.

Problem: There were no station announcements on some trains.

The 60 problems which were identified are distributed among 15 "requirements" along the trip. Of course, it must be noted that the problems also occur at locations other than those under which they are noted in the trip, but the requirements serve to alert the reader to the meaning of the problem.

The principal investigators next sought to identify potential solutions to the problems which had been isolated. The techniques used in this phase of the study were:

1) An exhaustive literature search for systems and/or devices which could solve the identified problems was conducted;

2) Consultants in transportation engineering and architecture met with with the principal investigators to discuss solutions which had been identified and to suggest alternatives;

3) Preliminary solutions were discussed at a national meeting of transit planners and architects representing 8 rapid rail systems as well as representatives of UMTA;

4) A survey of attitudes toward the proposed solutions was conducted on a sample of visually impaired travellers and on a sample of sighted travellers, in order to determine the anticipated benefits of the solutions as well as the possible hazards or inconveniences they might pose.

The results of this phase of the study show that many of the problems encountered by the visually impaired could be remedied 1) by low-cost minor modifications in transit stations and on trains (e.g., painting color-coded lines); 2) by consistently presenting information which is intended for regular presentation (e.g., announcement of stops); and 3) by compliance with existing standards for many fixtures and hazards (e.g., handrails, steps). Other, more elaborate solutions are discussed for the sake of planners who have the option of including various devices and designs in new stations and systems.

The reader may also wish to attend to the other two documents which resulted from this study, which are described below.

Volume II: Information About Visual Impairment for Architects and Transit Planners.

This document contains a) A Glossary of Terms Commonly Encountered in the Literature on Blindness and Orientation and Mobility; b) An Annotated Bibliography of Selected References on the Visually Handicapped; c) Considerations in the Design of Information Systems for Communicating with the Visually Handicapped; d) An Annotated Bibliography on the Use of Transit by the Blind; and e) Incidence and Demography of the Visually Impaired in the United States. The

document is designed to assist individuals who wish to design environments which will be free of barriers to the visually impaired.

Excerpts: Techniques Which Would Improve Communication with Visually Impaired Users of Rail Rapid Transit Systems.

This document presents a collection of techniques which, if adopted by rapid rail systems, would improve their use by the blind. The techniques include suggestions for a) signage and other print information; b) graphic information; c) auditory information; d) textural information; e) special equipment designs; f) architectural designs; and g) operating procedures. This document is a compact version of the solutions which are presented in the present volume.

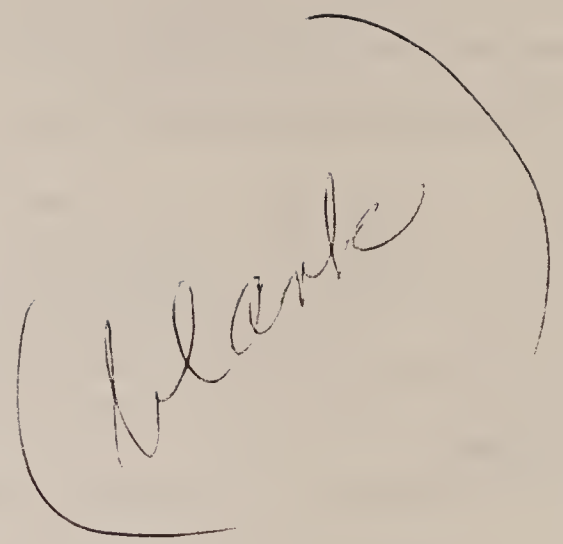


TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

Today, it is considered fundamental that members of racial minorities, the handicapped and the socially disadvantaged must receive equal protection under the law and equal access to the benefits of all social, educational and vocational opportunities. But it is important to realize that attempts to consummate this moral mandate are still being made. In recent times, social activism and governmental responsiveness have together produced positive changes in the areas of human rights legislation and enforcement. For example, the Education of All the Handicapped Children Act of 1975 and Section 504 of the Vocational Rehabilitation Act of 1973 have together laid the foundation for the full participation of the handicapped citizen in the mainstream of American life. Notwithstanding these and many other accomplishments in the area of equal opportunity, the stimulus for the research reported herein originates in the concern for the problems of the elderly and the handicapped in accessing public transportation.

The particular focus of this project is the visually impaired user of urban mass transit (with specific attention to the rapid rail mode). Throughout the conduct of the project, the principal aim has been to identify techniques that enable rail rapid transit systems to communicate more effectively with visually impaired travellers. This has been accomplished by systematically defining the universe of problems encountered by the visually handicapped in negotiating rapid rail systems, and then by identifying categories of solutions to share with the transit community in the form of suggested techniques for improving the ease and efficiency of travel.

The nature of such suggested techniques is not so easily understood by the normally sighted community because the particular problems for which each technique has been identified are not so apparent. In contrast,

the individual restricted to a wheelchair has many obvious but nevertheless serious problems negotiating the built environment. The apparent solution is to alter in some way the structure of the environment so that unobstructed wheelchair travel is a reality. More easily said than done, the immediacy of such a solution compels one to categorize all accessibility problems as structural or architectural.

But the accessibility problems of the visually impaired traveller are in no way limited to those which are imposed by structural barriers. Although the public's notion of how well blind persons navigate through the built environment is extremely variable, it is widely held that the blind are so incapacitated that when left unattended they must wander aimlessly through a world of darkness and gloom, precariously completing each step with the ever present anticipation of collision or fall. If one regards the blind in this manner, the indicated solution is to provide the traveller with a sighted companion who can assist in the avoidance of hazardous obstacles and sudden elevation changes, lead the traveller to his/her intended destination, and communicate all information necessary to the traveller for altering routes or changing destinations.

If one views the visually impaired individual in a more positive and realistic light, solutions become more approachable and less absurd. The experience of the totally blind is not one of darkness. Rather, the eyes simply cease to function as organs of visual reception so that all direct experience and imagination must be organized around the remaining senses. Through motivation and training, visually impaired individuals possess the capacities necessary for independent travel. With the aid of a long cane and/or reliance upon remaining impaired vision, such persons can learn to move safely and efficiently through the environment with grace in form and purpose in direction. Thus, the concept of barriers to accessibility for

the visually impaired must emphasize less structural design and more communication systems and operational procedures.

In the transit environment the visually handicapped traveller is concerned with the gathering of information (usually provided by transit planners) necessary to negotiate all aspects of the system. Of equal importance, the visually impaired traveller needs to determine the extent to which operational procedures of the system are compatible with his/her sensory capabilities. For example, can fare card and fare collection procedures be carried out without sighted assistance, or will trains be located consistently at platforms? There are some real challenges facing the visually handicapped traveller. But visually impaired travellers ought to be able to independently negotiate a trip on rapid rail transit without the benefit of assistance from other sighted travellers. Presuming that no other multihandicapping conditions are present, it is not unreasonable to require that trip time in the system and error frequency during travel need not significantly exceed what is ordinarily expected for sighted travellers.

A rationale for emphasizing independent travellers as the population of major concern for this project can now be advanced. In order to discover where rapid rail systems fail to adequately communicate with the visually impaired, one must start with a competent traveller already in the system. The problem then narrows to the point of determining how information necessary for barrier-free access can be obtained without benefit of vision or by means of severely impaired vision. To consider directly those visually impaired individuals who, for lack of training or desire, choose not to travel independently, would seriously contaminate the project's findings, by obscuring problem areas that ought to be addressed by the transit community with a whole array of concerns that can legitimately be addressed by the special edu-

cation and rehabilitation fields. This statement is not meant to imply that transit innovations will not extend transit service to individuals who previously did not use it. On the contrary, a far better match between performance capabilities of the visually impaired and transit system requirements should result by identifying those components of rapid rail access that depend most heavily upon the use of vision.

CHAPTER 2

BACKGROUND INFORMATION ABOUT THE VISUALLY IMPAIRED

A. The Functional Capabilities of Visually Handicapped Individuals

Today visually impaired citizens across the United States enjoy educational, vocational, and social opportunities far exceeding that which was experienced by preceding generations. Berthold Lowenfeld, noted scholar in the field of blindness, states that regard for the visually impaired from antiquity to modern times is best conceived as a gradual ascendancy from initial separation to the current age of integration (Lowenfeld, 1973). In order that the ideal of integration can be transformed into practicable opportunities, it is critical that our social and political institutions become aware of the nature of blindness and visual impairment.

The visually impaired population is extremely heterogeneous. This characteristic makes generalizations about the traits, states, attitudes, and needs of the visually handicapped most tenuous. The ambiguity of the term "blind" as legally defined is by itself sufficient to illustrate this point. The vast majority of the so-called legally blind population possesses substantial amounts of useful remaining vision. The nature and extent of this remaining vision further complicates the functional characteristics of the population. For example, some individuals possess a very small area of clear vision in the center of the visual field, and others operate with a large blind spot in the center. While some suffer from a general decrement in visual acuity, others experience erratic fluctuations in the quality of visual input.

Since the initial passage of social security legislation subsequent to the Great Depression, eligibility for nearly all services to the visually impaired has been regulated by a legal definition of blindness. To satisfy

this requirement, vision must be measured in the better eye after the best possible correction is made for such common refractive errors as nearsightedness and astigmatism. Should the individual fail to see any better than a standard image (e.g., the Snellen E at the top of an eye chart) at a distance of 20 feet, that most people can ordinarily see at 200 feet, vision is then considered so subnormal as to be considered legally blind. Alternatively, if the individual in his better eye can see in his field of vision no more than 20 degrees of arc, legal blindness is also satisfied. Many states have adopted an additional category of visual impairment, most often for special educational purposes. Partial vision, in its most precise meaning, refers to distance visual acuity between the cut-off for legal blindness and the 70 foot standard. That is, should an individual fail to see any better at a distance of 20 feet that which most people typically see at 70 feet, the criterion for partial vision is achieved, provided the measurement is taken in the better eye with best possible correction. These categories point up the fact that within the visually impaired population wide variations exist in terms of both visual status and ability to function.

Most recently, many service providers have attempted to operate under more positive criteria of eligibility. Rather than focusing upon physical stigmata or arbitrary measurement points, some agencies seek to relate the nature of the impairment to a functional limitation. Any visual status that prevents an individual from participating fully in the mainstream of society by not allowing access to opportunity would be considered a handicap. While such a functional definition permits a more appropriate match between potentially available service and human need, the population of the visually impaired becomes more heterogeneous.

In addition to the issues of definition and classification, it is no less a problem to determine the precise numbers of visually handicapped

citizens. Estimates are drawn from such sources as the Blindness Register maintained by the separate states, analyses of nationally representative localities and public health surveys. Depending on the criteria used for inclusion in the estimates, the figures may extend from a conservative 450,000 to well over 2,000,000. Because of advances in ophthalmic medicine and general improvements in the health care delivery system, one encounters few whose impairment may progress to complete blindness. Thus, the new frontier in the field of blindness is the study of low vision, involving the disciplines of ophthalmology, optometry, social work, special education and rehabilitation. This new field is concerned with the restoration of visual functioning through the use of technological aids, practical training, and counseling strategies.

Overlap with other populations exacerbates the problem of identifying the visually impaired by type and number further. For example, correlative with the process of aging is specific sensory and motor debilitation. Thus, diseases such as glaucoma, cataracts, macular degeneration and diabetes retinopathy occur with far greater frequency among the elderly. Visual impairment coincident with early childhood disease is another example of population overlap. Advances in prenatal screening, obstetrics, and early detection procedures has reduced the rate of infant mortality. Thus, today's population of visually impaired children is found to include a majority of multihandicapping conditions.

Today the most widely acknowledged mode for meeting the needs of the visually impaired is to provide individually tailored education or rehabilitation programs. The objectives of such programs are to help the individual acquire appropriate problem-solving strategies for overcoming the specific limitations associated with the particular visual impariment. Some limitations are the learned results of overprotection and overrestriction.

Other limitations may be the result of an inability to move safely and efficiently through the environment. Here, the strategies conveyed to the visually impaired individual are quite specific and well-established. Where compensatory approaches by themselves fail to meet the needs of the individual, technological aids in such areas as travel and communication are employed. In every instance, the adjustments necessary for full integration are encouraged to emerge in the individual. The success of the visually impaired in school and society is due largely to their ability to adjust to the changing demands of the real world.

A source of major concern to consumers and professionals in the field of blindness is the construction of environments which contain safety hazards difficult to detect and operational procedures difficult to negotiate. While the advances in education and rehabilitation can provide a blind person with the skill and knowledge necessary to function successfully on the job and travel independently on the street, the many and various changes which accompany improvements in the transportation field can, without intent, place severe restrictions on the handicapped traveller. The solution is not to construct facilities that accommodate to the needs of the blind as perceived by individuals who view them as helpless. Rather, the solution rests in the conviction that the visually handicapped can function independently in the mainstream of society, and those who construct environments for the greater good of the public should question the exclusive reliance upon vision to prevent inequities in ease of access.

B. The Incidence and Demography of Visual Impairment In the United States

Available data on the incidence and demography of blindness are incomplete and of suspect reliability. None of the population studies has been sufficient in scope to precisely identify the characteristics of this population in any reliable manner.

It must also be pointed out that this handicapped population represents a very small percentage of the total population of the United States (less than .01%). Therefore, samples selected using normal sampling procedures are subject to greater than normal error.

The numerous restrictions observed when deriving a sample population representative of the entire U.S. population (due to cost, privacy, etc.) make appropriately generalizable population studies difficult to design. This process has been beset with additional difficulties within the blindness field due to conflicting definitions of blindness and differing methods of determining visual function.

Nevertheless, various data collection techniques and estimating procedures have been attempted and a few studies have been conducted within the past two decades. Estimates generated by these studies are discussed below.

The National Health Interview Surveys (1963-1964) determined their estimates from responses during a house-to-house canvas of representative urban families. Severe visual impairment was recorded for negative responses to the question "can you read ordinary newsprint with glasses?" It should be noted, however, that this type of data collection is highly unreliable because of such factors as self-reporting, the variation of reading distances, possible visual improvements with other corrective lenses and other similar factors.

The Model Reporting Area (MRA) for Blindness Statistics was formed to facilitate more uniform collection of blindness statistics by the Biometrics Branch of the National Institute of Neurological Disease and Blindness (NINDB). For their purposes, blindness has been defined as visual acuity of 20/200 or less in the better eye with best correction, or visual acuity of greater than 20/200 if the widest diameter of the visual field subtends an angle no greater than 20 degrees (which is the typical requirement for SSI eligibility and for special services for the visually handicapped). Additional standards were followed by the sixteen MRA states during the 1970 data collection. Unfortunately, this program was phased out after 1971 in favor of other epidemiologic and statistical activities.

Although the population of the 16 states participating as Model Reporting Areas in the 1970 study comprised approximately 1/3 of the population of the entire U.S. population, the population does not represent all ethnic or geographical sections of the U.S., and their statistical findings cannot justifiably be generalized to the entire U.S. population. The MRA collection, though more uniform in definition and classification procedures than other register systems, still depended on thorough reporting of blindness cases by ophthalmologists and other blindness system professionals. Selective underreporting by these people due to personal biases, forgetfulness, and other factors probably occurred. The degree of underreporting is unknown, but the MRA is thought to understate the population size (Goldstein, 1980). Underreporting is considered to be especially

prevalent in the older age group (65+). This group may also have missed the blindness register because they received aid from agencies for the elderly and may not have been listed on the blindness register as well.

There are particular tendencies reported in the 1970 MRA study worth noting:

1) In this publication, at least 45% of all persons on the register were 65 years and older, and 43% of the new cases were within this age group.
2) The addition rates to the register have been approximately 10% of the rate on the register. (Additions to the register do not necessarily indicate the number of new cases or even the newly diagnosed cases.)
3) The rates for blindness in males are slightly higher than those for females until the older age range (65+). This shift is probably due to the larger proportion of females who reach the older age bracket.
4) Generally there is a higher incidence of blindness within the non-white population than the white population.
5) The causes of blindness shift within age groups. The most pertinent causes for the purpose of this study include retinal disease (diabetic and other), uveitis, glaucoma, and - in the older population - senile cataracts.

Although the trends are noteworthy, the lack of a true representative sample population would prohibit their use as indicators of

prevalence and incidence in the complete U.S. population.

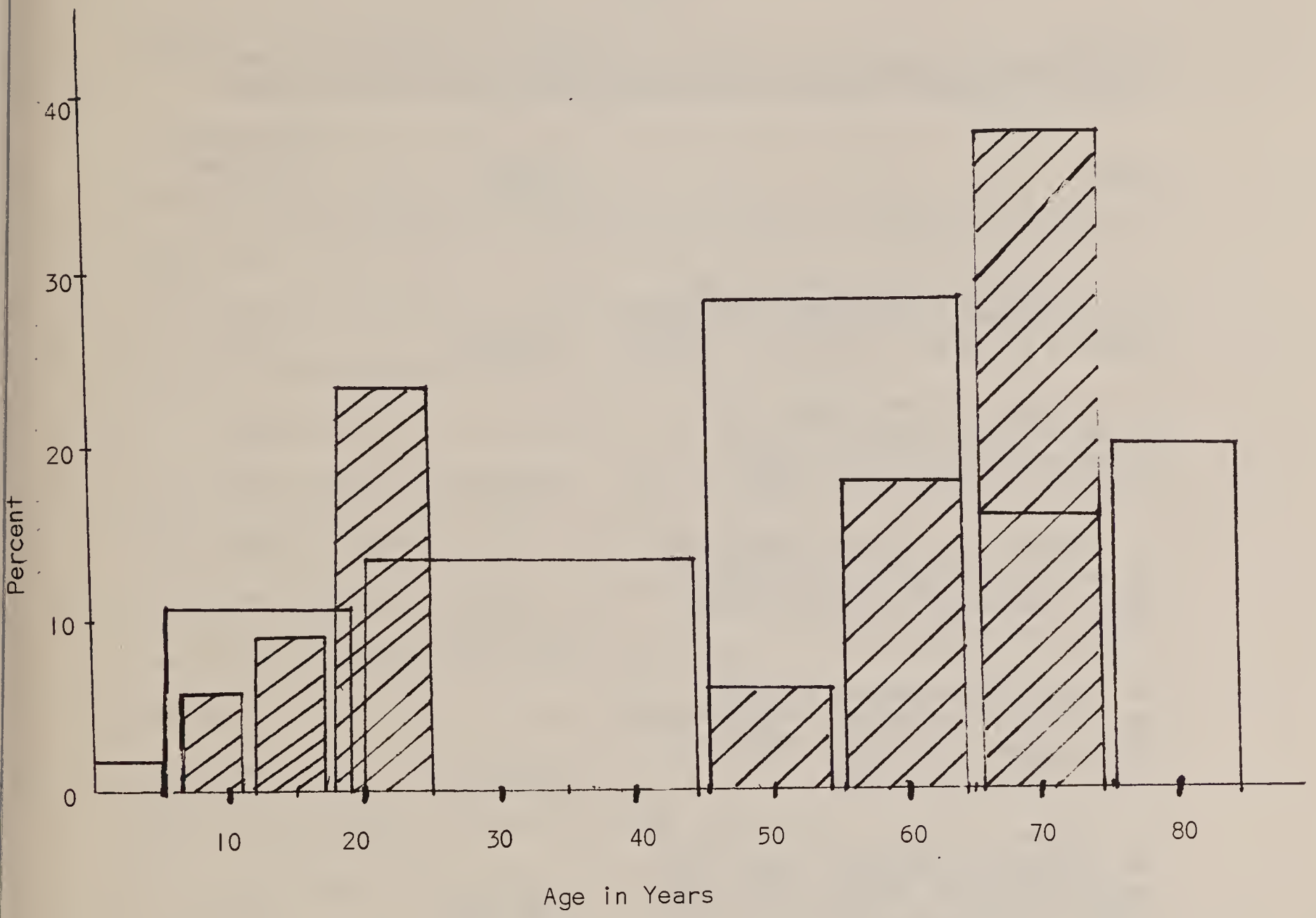
Hatfield (1970) estimated the size of the U.S. blind population using a weighting system. The formula involved projecting the population data collected from six of the MRA states to other states via a weighting system for other pertinent population characteristics. The limitations of this technique include the problems previously discussed for MRA systems such as underreporting, and other perils of projecting findings from a collection of six states to the other 44. Unfortunately, there is also no way to validate these estimates.

The first to report findings based on ophthalmological examinations of a statistically-based sample of the United States population was the Health and Nutrition Examination Survey, conducted in 1971-1972 by the National Center for Health Statistics for the age group 4-74 years. A sample of 14,497 persons representing the 192.7 million Americans aged 4-74 years was selected. The people were requested to report for an ophthalmological exam. Seventy-three percent of those requested participated. The reduced participation rate is thought to cause an understatement of the actual prevalence of severe visual handicaps.

As can be seen in Table 1, the percent distribution of persons with 20/200 acuity differs greatly from that indicated by MRA data. One particularly striking discrepancy is the lack of persons reported with severe visual impairment in the 25-44-year-old range.

Table 1.

Comparison of percent distribution by age of persons with 20/200 or worse visual acuity as reported by the National Center for Health Statistics 1971-1972 Health and Nutrition Examination Survey and the Model Reporting Areas for Blindness Statistics, 1970.



Model Reporting Area for Blindness Statistics, 1970

1971-1972 Health and Nutrition Examination Survey

Adapted from Goldstein, Table 2 and Table 30.

Table 2 summarizes the findings of various other blind population studies, and confirms the lack of agreement on total population size.

Table 2.

Estimates of the number and rate per thousand of the blind and severely visually impaired non-institutionalized population, United States.

STUDY	NUMBER	RATE PER THOUSAND
1. Estimate of the legally blind from 14 states in the Model Reporting Area for Blindness Statistics (1965)	290,000	1.5
2. Estimate of the legally blind by the National Society for the Prevention of Blindness (1972) (derived from Hurlin estimates)	467,800	2.1
3. Number in population aged 4-74 reaching specified acuity levels-- Health and Nutrition Examination Survey (1971-1972)	630,000	-
4. Number of persons 6 years of age and over who cannot read newsprint with glasses (1963-1964) National Health Interview Survey	1,227,000	6.6
5. Number of persons 18-79 years of age testing at 20/200 or less "corrected" distance vision (1960-1962) National Health Examination Survey	889,000	8.0
6. Number of persons reporting "severe vision impairment" (1963-1964) National Health Interview Survey	1,227,000	6.6
7. Number of persons 6 years of age and over who cannot read newsprint with glasses (1971) National Health Interview Survey	1,306,000	6.5

Adapted from Table 33, p. 184, Goldstein

C. Other Population Characteristics

Due to the contradictory estimates of the incidence and prevalence of blindness, it is very difficult to predict other characteristics within the population with accuracy.

However, of particular relevance to this project is an estimate of the number of the blind who would use and benefit from braille signs and maps (or large print maps). Goldish (1980) postulated that fewer than 160,000 people need to use braille, but his estimate was derived using the same formula used by Hatfield (1970), which was criticized earlier in this report.

Reading of braille varies with age and onset of blindness as well as educational factors. Goldish (1980) estimated that of the number of legally blind, 11% (about 45,000 people) read braille and 8% (33,000) use it as their primary mode of communication. By age group, 52% of the legally blind population under 20 years of age learn to read braille, 20% of the 20-39 age group, 10% of the 40-64 age group and only 3% of the legally blind population over the age of 65 read braille.

It is even more difficult to determine the number of persons who rely on large print. No population studies have been done in the U.S. in this area, although various agencies have stated particular recommendations.

Another important statistic for the purpose of this study is an estimate of the number of blind persons with more than one handicap. Additional handicaps usually complicate the travel abilities of the

visually impaired. The National Center for Health Statistics 1971-1972 Health and Nutrition Examination surveyed combinations of impairments. Out of the estimated 47,424,000 non-institutionalized people with some type of impairment, they reported 1,306,000 as having severe visual impairment only, and the following combinations of impairments including vision (not necessarily severe):

Vision and hearing	2,559,000
Vision and speech	130,000
Vision and paralysis	256,000
Vision and absence of extremity	148,000
Vision and other orthopedic	1,927,000

These estimates obviously are not of the "legally blind" population alone, although some legally blind persons would be included. The techniques used in this survey have been critiqued previously.

The number of visually handicapped persons who are trained to travel is unknown. Seeing Eye Institute estimates that between 2 and 5% of the blindness population could use a dog guide, but does not have exact numbers of persons who do use them.

No estimates of the number of people who use the long cane with or without training have been published. Also, no estimates have been made of the number of persons who use electronic travel aids, although most experts consider this population to be less than 1% of the blind population.

It is obvious that more research is needed on the incidence, prevalence, and distribution of blindness. The results of those studies which have been done cannot be considered reliable because of a lack of consistent definition of visual impairment, differing methods of determining visual needs, and a lack of consistent procedures for the reporting of visual handicaps.

These same factors also preclude the possibility of making reliable judgements on the size or distribution of sub-populations such as the elderly blind or the visually travel-impaired. The estimates discussed in this section reflect the state-of-the-art as of 1981, and until such time as the overall incidence is better known, it seems prudent to avoid making further breakdowns.

D. The Need for Barrier-Free Access to Urban Mass Transit by the Visually Impaired

The concept of the transportation handicapped includes individuals with specific visual impairments. Increasing the accessibility of mass transit for the visually impaired should improve the safety and efficiency with which all users negotiate the system. Further, such improvements should expand the purposes for which the visually impaired use the system. To explain, the transportation handicapped may be willing to risk danger and inconvenience for a necessary trip to and from work, but using the system for recreation and exploration requires a more equitable approach to accessibility. Also, improved accessibility should in the long run increase ridership among visually handicapped urbanites, since standards established from accessibility studies could be incorporated into existing educational and rehabilitative programming. With the unpredictability associated with mass transportation removed, many of the inhibitions limiting independent travel could be overcome.

Urban dwelling is preferred by many visually impaired persons because they are unable to drive an automobile and thus cannot personally use America's principal means of transportation. In order to avail themselves of the opportunities of employment, housing, education, and community services, visually impaired urbanites must have an accessible transit system. Such a system should not amplify or multiply the effect of a visual impairment, nor should it deprive the handicapped traveller of the anonymity enjoyed by others.

This project addresses specifically the mode of rapid rail in urban mass transit. Many of the problems discussed and the suggestions presented, however, will have applications in other transportation modes. One must be cognizant of the fact that a typical trip on many systems often involves more than one mode. The manner in which these distinct modes interface must also be considered when accessibility is desired.

CHAPTER 3

THE CONCEPT OF THE TRIP:

THE SEQUENCE OF DECISIONS VISUALLY IMPAIRED TRAVELLERS MUST MAKE WHILE NEGOTIATING RAIL RAPID TRANSIT

Visually impaired travellers can and do use rail rapid transit. Many visually impaired travellers regularly commute to work on rail rapid transit. Some of these experience little more difficulty than their fully sighted fellow travellers. There are no *a priori* factors which prevent a totally blind or low vision traveller from using rail rapid transit. However, there are many requirements made by transit which cannot be met without delay, inconvenience, inefficiency or loss of dignity by visually impaired travellers.

This project was concerned with enabling visually impaired persons who are independent travellers to use rail rapid transit with efficiency, convenience and dignity comparable to that experience by sighted travellers. An independent traveller, as used in this report, is a visually impaired person who does, at times, travel familiar or unfamiliar routes without the continuous use of a human guide. He has sufficient mobility skills to be safe, and sufficient orientation skills to not get lost on at least some parts of journeys. It is rare, however, to find visually impaired travellers, especially totally blind travellers, who do not need, at least occasionally, to solicit information from other persons. Some travellers solicit or accept information or assistance from a succession of fellow travellers for nearly every step of a journey on rail rapid transit.

It has been documented (Abt Associates, 1974) that need to request information is a barrier to public transit use for the general public. This has not been empirically confirmed as a factor preventing visually impaired

persons from using rail rapid transit. However, if this is true for persons who are able to visually locate a person and to see whether that person appears able to give the needed information, it cannot be less true for persons who cannot see or visually judge the capabilities of other persons.

Some visually impaired travellers have received instruction in negotiating public transit. This instruction typically includes the use of available sensory information for orientation (such as the sound of a door opening or of travellers passing through a turnstile), the use of travel aids such as the long cane (for information and protection), and the soliciting of aid from transit personnel or other travellers. The instruction is provided by a Peripatologist or Orientation and Mobility Specialist. Some visually impaired travellers are self-taught.

The transit requirements which pose the greatest problems for visually impaired travellers tend to be those associated with the need for information rather than those associated with the need for movement. The visually impaired traveller, for example, is more likely to have difficulty (be delayed or need assistance) because he cannot find the turnstile than because he cannot pass through the turnstile.

Transit recognizes the need to provide all travellers with information such as directions to particular lines and station names. Some of this information is often provided in forms such as large signs or audio announcements that are useful to some visually impaired persons. However, visually impaired persons have difficulty finding many facilities which transit expects travellers to locate by sight, such as station entrances, stairs, fare purchase devices, information kiosks, turnstiles, safe places to wait on platforms, vehicle doors, and seats and stanchions in vehicles.

A first major task of this project was to identify problems visually impaired persons experience in using rail rapid transit. These were expected

primarily to be communication problems. After the problems were identified, solutions could be found or proposed.

The first step in identifying problems was the completion of a detailed analysis of decisions visually impaired travellers must make in order to complete a trip using rail rapid transit, and of the available sources of information which may enable travellers to make correct decisions. This analysis was completed by principal investigator Billie Louise Bentzen who is an Orientation and Mobility Specialist.

The analysis was based on personal inspection of rail rapid transit systems in Boston (MBTA), Philadelphia (SEPTA and PATCO) and Atlanta (MARTA). Each decision a traveller must make was listed in order, beginning with the traveller's need for information about the route so that he could decide what line to take and at what stations he should enter and exit. The analysis continued through each decision the traveller must make in his journey, and ended with the need for information to tell the traveller his location when he had re-emerged from the station nearest his destination so that he could decide how to reach his final destination.

The four rapid rail systems were inspected to supply information about all the possible sources of information for making each decision. Most decisions could be made by the non-handicapped traveller using several different kinds of information. For example, the transit environment usually provides the following four sources of information to enable the traveller to decide in what direction to travel from the entrance to the fare barrier: 1) characteristic visible architecture or equipment; 2) Sounds of fare collection or validating devices; 3) other travellers; and 4) inference (e.g., "The fare barrier is usually straight ahead from the top/bottom of the stairs.")

Visually impaired travellers may be able to use some of these information sources where and when they are present. In the previous example, for instance, totally blind travellers cannot use characteristic visible architecture, but they may be able to use the other three information sources. Travellers having low vision may be able to use all four sources.

The available information sources may, however, not be useful to visually impaired travellers for a variety of reasons. For example, although normally sighted and some low vision persons may not have difficulty distinguishing the fare barrier, others may find the area hard to recognize because of poor lighting and contrast. Consistent, distinctive visual patterns having high contrast may characterize the fare barrier throughout a system, enabling even very low vision travellers to locate the fare barrier visually. However, when the visual patterns are inconsistent, this information source would be less useful because its use depends on the low vision traveller being able to anticipate a particular pattern - not to discriminate characteristic features of a fare barrier *per se*. Sounds of fare collection or validating devices are potentially useful to both totally blind and low vision travellers, but the devices may not emit sound unless other travellers are passing through. The characteristic sounds of these machines may also be at a frequency or intensity which makes them difficult to localize. Although both totally blind and low vision travellers can potentially follow other entering passengers to the fare barrier, other travellers may not always be present. Although both totally blind and low vision travellers can potentially infer the direction to travel from the entrance to the fare barrier, inconsistencies in placement lessen the reliability of inference.

It can be seen in the foregoing example that at many times and places both totally blind and low vision travellers have some information to tell them how to get from the entrance to the fare barrier. However, it is also

apparent that inconsistency or absence of any of the four usual sources of available information can make it very difficult for the visually impaired traveller to locate the fare barrier without information from or guidance by another person.

The normally sighted traveller is expected to easily see the fare barrier, not to need directions to it. The traveller who cannot see the fare barrier, if he has no other source of information about its location, can systematically search the physical environment using hands, feet, and/or a travel aid such as a long cane, until he encounters something which he recognizes as the fare barrier. This systematic haptic exploration of unfamiliar space is difficult, time consuming, undignified, and often dirty. In addition, if there is any potential access to hazardous areas, such haptic exploration may be unsafe.

The analysis of the trip, based on site visits in Boston, Philadelphia and Atlanta, is summarized in a lengthy table entitled "A Trip on Rail Rapid Transit; Decisions that Must be Made; Sources of information Available: Problems in Use", located in Appendix D. The following information is available in this table: 1) the decisions, in order as they occur on the trip; 2) sources of available information; 3) the degree to which these sources are useful to totally blind or low vision travellers; 4) the problems in existing information sources which limit their usefulness by the visually impaired; and 5) differences in the available sources depending on whether the station is at, above, or under ground level.

The general reader may not be interested in all the information available in this analysis. It will be especially helpful, however, for persons who are making decisions about how accessible a particular system or station is to visually impaired travellers. The analysis systematically lists all the

redundant information sources which transit often makes available to all travellers, and then tells which of these are useful to visually impaired travellers. Therefore, it can be used as a guide, step by step, through any trip on any system, to help determine the relative accessibility of that trip. In planning to implement techniques particularly helpful to visually impaired persons, any system should first analyze how useful the information provided for all travellers is for visually impaired travellers. In situations where potentially available information is lacking or is not made available in ways useful for the visually impaired, this table and Chapter 6, entitled "Techniques for Improving Communication with Visually Impaired Travellers in Rail Rapid Transit Environments", will give suggestions for enhancing available information sources or for providing specially adapted sources of information.

CHAPTER 4

PROBLEMS ENCOUNTERED BY VISUALLY IMPAIRED USERS OF RAIL RAPID TRANSIT

This chapter will present the procedures used to identify and analyze the problems experienced on rapid rail systems by visually impaired travellers, and the results of this study of problems.

A. Procedures

In order to identify the kinds of problems encountered by the visually impaired, the principal investigators completed background reading of pertinent documents, on-site research, and interviews with various individuals. Each of these efforts is described, in detail, below.

1) The investigators read numerous documents pertinent to the use of rail rapid transit by the blind. (Some of these documents have been annotated in Appendix H, "An Annotated Bibliography on the Use of Transit by the Visually Impaired".) The purpose of this background literature review was to familiarize the investigators with work on the identification of problems encountered by previous researchers.

2) An extensive task analysis was performed on rail rapid transit by an experienced Orientation and Mobility Specialist. In order to do this, a sample of trains, and elevated, ground level,and subway stations were walked through, while notations were made about the kinds of information needed by the traveller and the sources of this information. Afterwards, the entire trip was re-analyzed from the perspective of visually impaired travellers. A complete explanation of the procedure, and the task analysis itself, are presented in Chapter 3 and in Appendix D.

3) An Orientation and Mobility (O&M) Specialist who was familiar with the local rail rapid transit system was contacted in Boston, Philadelphia, and At-

lanta. Each of these three individuals was asked to identify nine blind travellers (3 aged 12-21; 3 aged 22-55; 3 aged 56-70) with whom they could travel through the local system, in order to observe the problems which the blind individuals encountered and to solicit the comments of the blind individuals themselves on the problem which were encountered. In order to insure that the same information was obtained from each traveller, a script was prepared by the principal investigators for use by the Orientation and Mobility Specialists. This script can be found in Appendix E.

The blind travellers were then walked through the local system either individually or in small groups, while the Orientation and Mobility Specialists kept continuously running audio tape recordings of their conversations based on the script. The 27 tape recordings were then transcribed for use by the principal investigators. A sample of these transcripts appears in Appendix F.

4) Based on the results of the above activities, an interview instrument was designed for use in telephone interviews with 81 blind subjects. The purpose of these interviews was to identify additional problems which had been encountered by blind travellers during their personal history, and to confirm or deny the validity of other issues which were suspected problems.

These 81 subjects represented the cells in the following matrix.

	Legally Blind: Acuity Problem	Legally Blind: Field Defect	Totally Blind
Age 12-21	3 Philadelphia 3 Boston 3 Atlanta	3 Philadelphia 3 Boston 3 Atlanta	3 Philadelphia 3 Boston 3 Atlanta
Age 22-50	3 Philadelphia 3 Boston 3 Atlanta	3 Philadelphia 3 Boston 3 Atlanta	3 Philadelphia 3 Boston 3 Atlanta
Age 51-70	3 Philadelphia 3 Boston 3 Atlanta	3 Philadelphia 3 Boston 3 Atlanta	3 Philadelphia 3 Boston 3 Atlanta

Although the sample was stratified according to the above criteria, it was not truly random. The 27 subjects who had participated in the walk-throughs were included in the sample, and names of other subjects known to use rail rapid transit, in each strata, were then solicited from agencies which service blind people in each of the three cities. In order to have made the sample truly random, it would have been necessary to have obtained the names of all blind independent travellers in each strata, a task beyond the funding of this project. While this technique may be seen as a minor limitation of this study, no attempt was consciously made to bias the selection of participants in any way, and the authors do not feel that the composition of the sample affected the results in any major way.

Other noteworthy characteristics of this sample were:

1) 45 males and 36 females were included;
2) 37 subjects were long cane users, 6 were users of dog guides, and 3 were users of electronic travel aids;
3) 40 of the subjects had been trained to use their mobility aid by an Orientation and Mobility Specialist;

4) 11 of the subjects averaged 8 or more rail rapid transit trips per week, 14 used it from 1-7 times per week, 20 reported using it from 1-3 times per week, and the remainder averaged less than 1 rapid rail trip per month;

5) 26 different etiologies (of visual disorders) were represented;

6) The onset of the visual disorder in approximately 40% of the subjects had occurred at birth.

It is also pertinent, at this point, to briefly discuss the range of travel abilities represented by this sample.

There are many factors which contribute to the success and comfort of visually impaired travellers in rail rapid transit systems. Some of these are skill factors, such as quality of use of the long cane or dog guide, while others are personal or psychological factors, such as appearance, memory, and solicitation skills. It is difficult to accurately scale these factors along measurable dimensions, but it can be assumed that visually impaired individuals vary considerably along continua from "Poor" to "Excellent" on each of these factors. Furthermore, the same person may perform at different qualitative levels at different times, due to confounding variables such as stress or fatigue.

The subjects who were interviewed in this study were experienced independent travellers. Experienced independent travellers were chosen because it was felt that they would not be unduly influenced by transient difficulties which, after brief experience, would no longer present problems to travellers competent enough to venture into rail rapid transit systems alone. However, it must be noted that even among the group which was chosen, proficiency varies considerably. In general, they are sufficiently adept at travel so that they regularly succeed in reaching their destinations, but they may, nevertheless, encounter unique problems and unnecessary diffi-

culties along the way.

5) The 3 Orientation and Mobility Specialists who accompanied the blind subjects through the systems, and 5 other Orientation and Mobility Specialists who were familiar with problems encountered by blind individuals attempting to use rail rapid transit were also interviewed. The purpose of these interviews was twofold. First, it was expected that the Orientation and Mobility Specialists who had accompanied the 27 subjects through the systems would be able to validate and further expand on problems encountered during the walk-throughs. Second, it was expected that the other Orientation and Mobility Specialists would be able to supply additional data on the prevalence and degree of problems which they had witnessed when attempting to teach naive blind travellers to use the systems in the three cities.

These interviews were conducted as "Nonschedule Standardized" interviews, where the same items are discussed with each respondent, but in a conversational format which allows for discussion, expansion, clarification, and the reporting of anecdotal data to supplement responses. The 3 Orientation and Mobility Specialists who had participated in the walk-throughs were asked to comment on problems based on their observations during the walk-throughs, but were allowed to comment on problems which they had observed at other times as well. The other 5 Orientation and Mobility Specialists were asked to comment on problems based on their observations of "relatively naive" travellers, who were not first-time users but who had only used a rapid rail system a few times. However, they also were encouraged to report on problems which they had witnessed at any time, by any visually impaired travellers.

B. Results

The anecdotal reports supplied under the various formats described earlier, as well as the literature review, the Task Analysis, and the personal observations of the principal investigators, all contributed to an extensive list of potential problems which could affect the visually impaired traveller who attempts to use rail rapid transit.

The authors have chosen to present these problems in the format of a trip through a rapid rail system. On this "trip", the requirements imposed upon the traveller by the rapid rail system* are followed by descriptions of the problems which were uncovered in this study which relate to those requirements.

It should be noted, however, that the problems may actually occur at many points along the trip, rather than just at the point at which they are noted. For example, the lack of large print signs presents a problem at all locations where information is presented on signs, not only upon entering the station (where the problem is described on the "trip").

Furthermore, the number and location of stations or trains on which these problems exist is not specified or implied, and no ranking of the severity of the problem is expressed or implied by the order of presentation. A major reason for this is that the frequency and severity of the problems is influenced by shifts in the general rapid rail environment during the course of the day. For example, the problem statement, "There were farecard machines in which the farecard had to be inserted in a unique manner" (see II.D.1 on Table 3) might seem to describe a trivial problem

*The requirements and trip descriptions are taken from "UTD Program Plan for Improving Transit Accessibility for the Elderly and Handicapped. Volume I: Background Issues and Recommended Approach", p. 39 a, b, c.

unless the reader envisions a crowded station in which a line of people are attempting to hurry through the gate. Similarly, the problem statement "There were trains which sat silently in stations, and they could not be recognized until their doors closed" only describes a problem if the traveller is in a nearly empty station where there is no one to ask and there are no crowd noises to use for clues.

Finally, each problem is followed by a superscript indicating that the problem may apply to all blind individuals or only to certain sub-groups.

Table 3. Problems Experienced by Visually Impaired Travellers on Rail Rapid Transit Trips.

I. Access to Station

A. Requirement: User must identify the station and locate the entrance.

1. Problem: There was a lack of consistent signage or architectural clues which could be used to find the entrance to some stations.

II. Accessibility Within Station

A. Requirement: User must perceive and understand information about the correct platform, train, and direction.

1. Problem: Some signs were located too high or in inconsistent locations.[1]

2. Problem: Some signs were poorly lit, which hindered attempts to read them.[1]

3. Problem: Some signs were dirty and/or defaced.[1]

4. Problem: Some signs had low contrast between print and background or had high color saturation.[1]

5. Problem: Some signs, especially glossy baked enamel ones, were difficult to read because of glare.[1]

6. Problem: Some signs were written in small print only.[1]

7. Problem: There were no large print maps.[1]

8. Problem: The contrast between color codes was too low to be useful as a clue on some signs.[1]

9. Problem: Poor lighting made maps and large print signs less distinguishable.[1]

B. Requirement: User must be able to pass through doors.

[1]Problem for the legally blind who have some residual vision.

[2]Problem for the totally blind.

[3]Probably only a problem for blind travellers in unfamiliar environments or for inexperienced travellers.

(continued)

1. Problem: Doors which opened outward and were in the path of travel were dangerous obstacles which could be walked into.[1,2,3]

C. Requirement: User must approach fare barrier/ticket booth.

1. Problem: There was no standard location of the entry gate or turnstile, which made it difficult to locate the appropriate gate.[1,2]

2. Problem: There was no textured or otherwise tactually discernable path to gate which could be consistently used.[1,2]

3. Problem: There were narrow turnstiles which were difficult to pass through with dog guides.[1,2]

4. Problem: There was no standard location for the information/change booth.[1,2]

5. Problem: There was a lack of distinction between entry and exit turnstiles in some places.[2]

6. Problem: The section of the "handicapped gate" on which the user was supposed to push when buzzer sounded was texturally unmarked, and the traveller pushed on the area adjacent to the gate rather than on the gate itself.[2]

D. Requirement: The user must manipulate currency or show "proof of payment".

1. Problem: There were farecard machines in which the farecard had to be inserted in a unique manner.[1,2]

2. Problem: There were coin or token slots which had no contrast to the rest of the fare collection device, which made finding the slot a matter of trial and error.[1,2,3]

3. Problem: Narrow money slots were the only passage for voice communication with attendants in some places, which made conversation very difficult.[1,2]

E. Requirement: The user must travel along the platform to wait for the train.

---

[1]Problem for the legally blind who have some residual vision.

[2]Problem for the totally blind.

[3]Probably only a problem for blind travellers in unfamiliar environments or for inexperienced travellers.

Table 3 (continued)

1. Problem: There were station platform edges marked with badly faded painted lines which were not sufficiently distinct from their adjacent area.[1]

2. Problem: There were station platform edges without guardrails.[1,2,3]

3. Problem: There were station platform edges with textured strips which were not of sufficient contrast to the adjacent area so as to serve as tactile warnings.[1,2]

4. Problem: There were repaired areas of pavement which were re-surfaced with textured material that gave false clues.[2,3]

F. Requirement: The user must be able to avoid hazards.

1. Problem: There were cracks and breaks in the pavement which could cause falls.[1,2]

2. Problem: There were litter baskets in potential travel paths.[1,2,3]

3. Problem: There were benches in potential travel paths where other travellers could be touched by canes, which places the traveller in an awkward social situation.[1,2]

4. Problem: There were newspaper and display racks in potential travel paths.[1,2,3]

5. Problem: There were poles and columns in potential travel paths.[1,2,3]

6. Problem: There were protruding telephone stations which did not project low enough to be detected by a cane.[1,2]

7. Problem: There were visual construction warnings which were attached to sawhorses located in potential travel paths.[1,2]

G. Requirement: The user must negotiate vertical movement.

1. Problem: There were escalators which can be especially difficult to board and exit under stressful conditions.[1,2]

2. Problem: There were handrails which did not project beyond the tops or bottoms of stairs.[1,2,3]

---

[1]Problem for the legally blind who have some residual vision.

[2]Problem for the totally blind.

[3]Probably only a problem for blind travellers in unfamiliar environments or for inexperienced travellers.

Table 3. (continued)

3. Problem: There were cluttered and littered stairs.[1,2]

4. Problem: There was no high contrast warning strip on some stair edges.[1]

5. Problem: Glare from windows was found on stairs, which may suddenly deprive travellers of visual clues.[2]

6. Problem: There was no clear visual or textural marking which clearly indicated the top step, which in some cases was the sidewalk.[1,2]

7. Problem: There were breaks in handrails at landings, which caused confusion when staircases changed direction at landings.[1,2]

8. Problem: There were greasy, filthy handrails which made use of the rail undesirable.[1,2]

H. Requirement: The user must identify the correct train.

1. Problem: There were no train announcements (name or destination) in stations.[1,2]

2. Problem: There were trains which sat silently in stations, and they could not be recognized until their doors closed.[2]

I. Requirement: The user must observe and approach the train door area and enter the vehicle.

1. Problem: The open doorway could not be quickly located.[2]

2. Problem: There were open spaces between cars on trains which were mistaken for doors.[2,3]

3. Problem: The gap between the platform and train presented a stumbling hazard.[1,2,3]

III. Access Within the Vehicle

A. Requirement: The user must identify a vacant seat.

1. Problem: There were no designated seats on some trains, which should be designated near the door of the train.

[1]Problem for the legally blind who have some residual vision.

[2]Problem for the totally blind.

[3]Probably only a problem for blind travellers in unfamiliar environments or for inexperienced travellers.

Table 3. (continued)

B. Requirement: The user must move along the aisle, possibly during train movement, or must ride standing.

1. Problem: Packages were placed in aisles by passengers, which were obstacles and which gave misleading clues.[1,2]

2. Problem: There was a lack of standard locations (among trains) of posts for grasping to maintain balance.[1,2,3]

3. Problem: No auditory warning was given before the train accelerated or decelerated to a halt.[1,2]

C. Requirement: The user must identify the desired stop or station.

1. Problem: There were no station announcements on some trains.[1,2]

2. Problem: There were no tactile maps available.[1,2]

D. Requirement: The user must be able to exit the vehicle.

1. Problem: There was no forewarning of the side of the car on which doors would open for exit.[1,2]

IV. Accessibility Upon Leaving the Station

A. Requirement: The user must be able to exit the station.

1. Problem: Some ends of platforms were not adequately blocked, and could be fallen off while other cues were being attended to.[2,3]

2. Problem: Some exit turnstiles were made of floor-to-ceiling horizontal bars, which were dangerous when in motion.[1.2]

3. Problem: Walls made of bars rather than being solid led to inappropriate auditory localizing, because of the irrelevant and confusing sounds from the other side of the barrier.[2]

4. Problem: There were "blind alleys" which were unmarked or only marked with visual signs.[1,2]

---

[1]Problem for the legally blind who have some residual vision.

[2]Problem for the totally blind.

[3]Probably only a problem for blind travellers in unfamiliar environments or for inexperienced travellers.

Table 3. (continued)

V. Systemwide Problems of a General Nature

1. Problem: Route information available by telephone was incomplete or was not informationally expanded for blind users (e.g., number of stops between entry and exit stations was not available).[1,2]

2. Problem: Rest rooms were unavailable in some stations.[1,2]

3. Problem: Rest rooms were locked and/or unmarked in some stations, and attendants who could open the door were difficult to find.[1,2]

4. Problem: There were no raised letters or braille signs to identify such places as rest rooms.[1,2]

5. Problem: There were no auditory cues to beckon travellers to safe exits in an emergency.[1,2]

---

[1]Problem for the legally blind who have some residual vision.

[2]Problem for the totally blind.

[3]Problem only a problem for blind travellers in unfamiliar environments or for inexperienced travellers.

CHAPTER 5

REACTIONS TO THE IMPLEMENTATION OF POTENTIAL SOLUTIONS

A. Reactions of Consumers

The principal aim of this project has been to identify techniques that enable rail rapid transit systems to communicate more effectively with visually handicapped travellers. In an effort to more fully appreciate the problems encountered by such users of mass transit, data was obtained from direct observation of blind and visually impaired individuals negotiating a "trip" on rapid transit, a telephone survey of 81 travellers from three major U.S. cities, and an extensive literature search. This pool of information provided an elaborate organization of those problems that regularly affect the visually impaired traveller.

Further literature searches and consultations with experts from the transit and blindness community resulted in the compilation of a working document entitled: "Review of Existing and Proposed Modifications of Devices and Systems in Rail Rapid Transit Which Affect the Travel of Visually Impaired Persons" (see Appendix I). After distribution to and feedback from members of the project's national liaison network, the project staff was then able to categorize some of the modifications as potential solutions to the problems identified earlier. However, certain of the solutions cited in the working document, it appeared to the project staff, could acquire greater external validity if corroborated by visually impaired users of rail rapid transit systems.

To this end the 27 subjects who had served in the original on-site research were asked tc respond via telephone to a questionnaire describing various transit modifications. Because each subject was experienced at independent travel in his or her respective system, the anticipatory set with

which each item was approached had to be addressed by the project staff. The following scenario was read to each respondent at the outset of the interview with the intent of exerting some control over prior experience.

> Suppose that a large modern city in another region of the country is planning to construct a modern rail rapid transit system consisting of a complex network of elevated, subway, and ground level stations. This system, intended to be fully accessible to the handicapped traveller, will interconnect the various neighborhoods of the city with four separate lines.
>
> Officials of the city's transit authority have contacted you for your opinion regarding some design proposals. Realizing that you may have particular and unique transportation needs, the transit authority is interested to know if you think certain recommendations should be put into practice. It is very important, therefore, for you to answer a series of questions from your own personal perspective.
>
> What follows is a series of statements that you could make about your own preferences in the use of rapid rail transit systems. Listen to each statement and think about the degree to which you agree or disagree with it. Please indicate your opinion by stating that you:
>
> 1) strongly agree
> 2) somewhat agree
> 3) have mixed feelings
> 4) somewhat disagree
> 5) strongly disagree

As can be seen from the text, this scenario conceptually placed the respondent in a completely unfamiliar transit environment, but one which at least purported to be ideal. Moreover, the notion that each interviewee was to speak only for him/herself was repeatedly reinforced. In this way the likelihood that the respondents would react from a position of advocacy was obviated.

Thirty-nine statements comprised the item pool for this survey. Not all potentially useful environmental and operational modifications were included since many seemed immediately appropriate in the judgement of the project staff. Worded in the first person, each statement attempted to express a preference for a modification described in literal terms without

reference to function or application. Thus respondents experienced at independent travel had to deduce the modification's function in order to indicate their extent of agreement. Some of the items were designed to tap the attitudinal set of the subjects by soliciting opinions on the virtues of independent travel. This was intended to confirm individually what was already known about the subjects collectively.

An additional questionnaire was formulated for a group of 30 normally sighted respondents from the Boston area, all users of rapid rail. Each was read the following:

> A number of changes or modifications have been proposed to aid certain users of public transportation. We would like to know how some of these alterations, if carried out, would influence your use of the red, orange, or blue lines here in Boston. Please keep in mind that we are concerned with your own personal opinion, so try not to answer for any other individual or group that you think might be helped by the modifications.
>
> Below are listed brief descriptions of ways by which transit environments may be modified. Please indicate the extent to which each modification will help or impair your travel. The following scale should be used to express your opinion:
>
> 1) Very helpful in aiding my travel
> 2) Somewhat helpful in aiding my travel
> 3) Has no influence on my travel whatsoever
> 4) Somewhat impairs my ease of travel
> 5) Seriously impairs my ease of travel

Selected from a pool of students at Boston College and neighbors of the project staff, care was taken to omit individuals acquainted in any way with the nature of the project. Additionally, to prevent evoking whatever attitude the subjects may have had toward the blind or blindness, this introduction avoided any such reference. Rather, the sighted respondents were encouraged to react in terms of their own needs and preferences. Twenty-eight of the 39 items from the survey for visually handicapped travellers were restated for the normally sighted with the hope of learning which, if any, of the potential modifications would prove helpful or undesirable for the sighted traveller.

Summary of Results

Below is a literal listing of the items for each of the questionnaires. Next to each item statement can be found the percent of the total number of respondents who chose each rating. Thus, the opinions of the visually impaired and normally sighted samples can be easily ascertained. Following these tables is a discussion of pertinent findings. (A further breakdown of data for each survey can be found in Appendix H, in which ratings by age and degree of visual impairment (visually impaired subjects only) can be examined. However, since total sample size for each questionnaire is quite small, the value of looking at any particular stratification is extremely limited. The intent of the investigators was not to survey either population in a truly representative manner, but rather to gain the informal reactions to certain categories of solutions from real consumers of rapid rail transit service.) A discussion of the findings follows the tables.

Table 4.

Percent of All Blind Respondents Selecting Each of the Response Choices

Question	SA	SWA	MF	SWD	SD
1. I feel that names of stops should routinely be announced on the train.	96.3	3.7			
2. I feel that as the train on which I am riding enters a transfer station, the name of the connecting line should be announced.	77.8	14.8	3.7	3.7	
3. I feel that each time a train arrives in a station, its destination should be announced so that I can hear it from the platform on which I am standing.	81.5	14.8	3.7		
4. I feel that the destination of a train should be announced from inside the train after the train has arrived in the station and doors are opened. I should be able to hear this from the platform.	48.1	33.3	11.1	7.4	
5. I feel that approaches to changes in elevation such as stairways, escalators, and ramps should be marked by a surface that I can feel with my cane or foot.	61.5	23.1	7.7	7.7	
6. I feel that the edges of all steps in a station should be marked with a brightly contrasting color.	94.7	5.3			

SA-Strongly Agree
SWA-Somewhat Agree
MF-Mixed Feelings
SWD-Somewhat Disagree
SD-Strongly Disagree

Percent of All Blind Respondents Selecting Each of the Response Choices

Table 4. (continued)

Question	SA	SWA	MF	SWD	SD
7. I feel that approaches to various changes in elevation such as stairways, escalators, and ramps should be coated with a brightly contrasting color.	89.5	10.5			
8. I feel that handrails on all stairways should be painted with a color that contrasts brightly with the background.	68.4	21.1	5.3	5.3	
9. I feel that when flights or series of stairs are connected with small platforms, the handrails from one set of steps to the next should not be interrupted.	59.3	29.6	3.7	3.7	3.7
10. Pathways whose texture I can feel underfoot or with my cane should be installed in stations so that I can stay on a route of travel from the entrance all the way to the platform.	46.2	26.9	11.5	11.5	3.8
11. Stations should have pathways laid down that contrast brightly with the remaining flooring so that I can follow a direct route from the entrance all the way to the platform.	63.2	31.6			5.3
12. I feel that if pathways are installed in stations, they should have some means of indicating direction so that entering, exiting, and connectin paths are not confused.	77.8	18.5			3.7

SA-Strongly Agree
SWA-Somewhat Agree
MF-Mixed Feelings
SWD-Somewhat Disagree
SD-Strongly Disagree

(continued)

Percent of All Blind Respondents Selecting Each of the Response Choices

Table 4. (continued)

Question	SA	SWA	MF	SWD	SD
13. I feel that a strip of material that can be detected by my foot or with my cane should be installed a short distance from the platform edge.	92.3	3.8	3.8		
14. I feel that a brightly colored strip of material should be placed along the platform a short distance from the edge of the track bed.	100.0				
15. I feel that some places in the station should be indicated by a soft sound signal that can be heard from short distances.	26.9	38.5	15.4	7.7	11.5
I would find this soft sound signal useful at:					
16. station entrances.	40.0	28.0	16.0	8.0	8.0
17. fare gates or turnstiles	44.0	24.0	16.0	8.0	8.0
18. stairways and escalators	48.0	20.0	16.0	8.0	8.0
19. train doors	56.0	20.0	8.0	4.0	12.0
20. station exits	40.0	24.0	16.0	12.0	8.0
21. I feel that these soft sound signals should not be constant but rather they should be activated by a pocket-sized device that I can carry and use as I choose.	30.8	34.6	11.5	7.7	15.4

SA-Strongly Agree
SWA-Somewhat Agree
MF-Mixed Feelings
SWD-Somewhat Disagree
SD-Strongly Disagree

Percent of All Blind Respondents Selecting Each of the Response Choices

Table 4. (continued)

Question	SA	SWA	MF	SWD	SD
22. Stations should be equipped with signs that talk when I stand near them and activate them with a pocket-sized device.	37.0	22.2	25.9	3.7	11.1
23. Stations should be equipped with signs that talk when I aim a hand-held device at them.	25.9	22.2	22.6	14.8	14.8
24. I feel that all written or map information mounted in stations should have a distinctively colored light mounted directly above, about eight to ten feet from the floor.	64.7	11.8	17.6		5.9
25. I feel that the separate lines of a rapid rail system should be designated by color, e.g., red, green, orange, and blue. These colors could be prominent in all signs as well as station and train decor that relate to a particular line.	77.8	5.6	11.1		5.6
26. I feel that signs indicating the names of stations should be located inside of color bands painted along station walls.	77.8	11.1	11.1		
27. Fare cards should have a touch system so that I can always determine the card's current value and its direction for insertion into a fare gate machine.	66.7	16.7	8.3	4.2	4.2

SA-Strongly Agree
SWA-Somewhat Agree
MF-Mixed Feelings
SWD-Somewhat Disagree
SD-Strongly Disagree

(continued)

Percent of All Blind Respondents Selecting Each of the Response Choices

Table 4. (continued)

Question	SA	SWA	MF	SWD	SD
28. I feel that the transit system should have a telephone information service that could identify appropriate landmarks for me and explain neighborhood layout for me in understandable terms.	51.9	22.2	11.1	3.7	11.1
29. Trains should always have a conductor available to assist me to my seat as well as assist me in boarding and exiting.	12.0	16.0	16.0	32.0	24.0
30. Transit workers should have a better understanding of the difficulties related to my visual impairment.	73.1	19.2	3.8		3.8
31. Stations should always have a transit worker available to give me directions.	51.9	18.5	14.8	11.1	3.7
32. Stations should always have a transit worker available to guide me safely to the train.	15.4	19.2	15.4	30.8	19.2
33. A warning strip near the platform edge is not needed because I can either detect the drop-off by cane or see it with my low vision.	3.8	15.4		15.4	65.4
34. I feel that sound signals should not be installed because the public would think that I, as a visually impaired person, am helpless and dependent.	11.5		7.7	15.4	65.4

SA-Strongly Agree
SWA-Somewhat Agree
MF-Mixed Feelings
SWD-Somewhat Disagree
SD-Strongly Disagree

(continued)

Percent of All Blind Respondents Selecting Each of the Response Choices

Table 4. (continued)

Question	SA	SWA	MF	SWD	SD
35. Sound signals always cause annoying noise pollution.	3.8	11.5	19.2	26.9	38.5
36. I would not use activated sound signals or talking sign systems because I would not want to carry the pocket-sized device around while travelling.	7.7	3.8	7.7	26.9	53.8
37. I feel that transit systems should make available to me whatever public information, such as maps and schedules, they provide to the normally sighted traveller. This information should be in a form preferred by me such as braille, large print, or audio cassette.	70.4	14.8	14.8		
38. My greatest difficulty in travelling in unfamiliar stations and systems is that signs are not consistently located so that I have trouble finding them.	47.1	17.6	23.5	11.8	
39. Signage in stations and on trains should be distinctive enough to see without low vision aids.	78.6	14.3		7.1	

SA-Strongly Agree
SWA-Somewhat Agree
MF-Mixed Feelings
SWD-Somewhat Disagree
SD-Strongly Disagree

Table 5.

Percent of All Sighted Respondents Selecting Each of the Response Choices

Question	VH	SWH	HNI	SWI	SRI
1. Names of stops should be announced on the train.	44.8	31.0	24.1		
2. When trains are entering a transfer station, the name of the connecting line should be announced.	41.4	27.6	27.6	3.4	
3. Each time a train arrives in a in a station, its destination should be announced so that it can be heard from the platform.	48.3	24.1	27.6		
4. The destination of a train should be announced from inside the train after the train has arrived in the station and doors are opened. This should be heard from the platform.	17.2	34.5	37.9	3.4	6.9
5. Approaches to changes in elevation, such as stairways, escalators, and ramps should be marked by a surface that can be felt underfoot.	17.2	20.7	58.6	3.4	
6. The edges of all steps in a station should be marked with a brightly contrasting color.	24.4	44.8	31.0		
7. Approaches to various changes in elevation such as stairways, escalators, and ramps should be coated with a brightly contrasting color.	10.3	37.9	51.7		

VH-Very Helpful
SWH-Somewhat Helpful
HNI-Has No Influence
SWI-Somewhat Impairs
SRI-Seriously Impairs

(continued)

Percent of All Sighted Respondents Selecting Each of the Response Choices

Table 5. (continued)

Question	VH	SWH	HNI	SWI	SRI
8. Handrails on all stairways should be painted with a color that contrasts brightly with the background.	6.9	37.9	51.7		3.4
9. When flights or series of stairs are connected with small platforms, the handrails from one set of steps to the next should not be interrupted.	17.2	27.6	55.2		
10. Pathways whose texture can be felt underfoot should be installed in stations so that a route of travel from the entrance all the way to the platform can be maintained.	6.9	20.7	65.5	6.9	
11. Stations should have pathways laid down that contrast brightly with the remaining flooring so that a direct route can be followed from the entrance all the way to the platform.	13.8	31.0	51.7	3.4	
12. If pathways are installed in stations, they should have some means of indicating direction so that entering, exiting, and connecting paths are not not confused.	24.1	41.4	31.0	3.4	
13. A strip of material that can be detected underfoot should be installed a short distance from the platform edge.	34.5	20.7	44.8		
14. A brightly colored strip of of materials should be placed along the platform a short distance from the track bed.	27.6	34.5	37.9		

VH-Very Helpful
SWH-Somewhat Helpful
HNI-Has no Influence
SWI-Somewhat Impairs
SRI-Seriously Impairs

(continued)

Percent of All Sighted Respondents Selecting Each of the Response Choices

Table 5. (continued)

Question	VH	SWH	HNI	SWI	SRI
15. Some places in the station should be indicated by a soft sound signal that can be heard from short distances.	7.1	10.7	67.9	10.7	3.6
Soft sound signals should be placed at:					
16. station entrances	14.8	7.4	70.4	7.4	
17. fare gates or turnstiles	11.1	18.5	63.0	7.4	
18. stairways and escalators	14.8	18.5	63.0	3.7	
19. train doors	21.4	7.1	64.3	7.1	
20. station exits	14.8	3.7	74.1	7.4	
21. These soft sound signals should not be constant, but rather they should be activated by a pocket-sized device that can be carried and used by the traveller when desired.	10.3	3.4	58.6	17.2	10.3
22. Stations should be equipped with signs that talk when the traveller stands near them and activates them with a pocket-sized device.	10.3	10.3	62.1	10.3	6.9

VH-Very Helpful
SWH-Somewhat Helpful
HNI-Has no Influence
SWI-Somewhat Impairs
SRI-Seriously Impairs

From an examination of the results, one must conclude that overall, both sighted and visually impaired users of rapid rail transit were quite positive in their acceptance of the "proposed" system modifications. Surprisingly, many of the system alterations described to the sighted group were judged to be helpful in aiding their travel, despite the fact that such modifications were contrived for the particular benefit of the visually impaired.

Because the ordering of items on each questionnaire centers around categories of solutions, it is convenient to discuss clusters of responses from each survey simultaneously. On the visually impaired survey, items 1 through 4 describe an on-board announcement system providing progressively more information to the traveller. Over 80% of the respondents either strongly or somewhat agreed with each of these items, indicating strong support for such a source of information. Responses from the sighted subjects were also quite positive with the exception that 10% felt that item 4 (announcement of destination as door opens) would either somewhat or seriously impair their travel. Admittedly, this item is stated somewhat imprecisely in that subjects cannot clearly imagine the situation described.

Items 5, 6, and 7 describe color and textural codings for elevation changes. This category was also received quite positively by the visually impaired subjects, and interestingly, the sighted subjects also responded in a way indicating the informational value of such environmental signals.

Items 8 and 9 refer to color coding and continuation of handrails. These were received favorably by the visually impaired subjects. The majority of the sighted sample responded neutrally with the remainder giving positive ratings. Items 10, 11, and 12 describe a tactile graphic pathway for in-station guidance. This notion received rather strong support from

the visually impaired and showed particular concern for some system for identifying the directionality of the pathway. The sighted subjects were again supportive of this concept as an aid for facilitating their own travel.

Item 13 describes a warning strip at the platform edge. This received overwhelming support from the visually impaired respondents, and was also supported by the majority of the sighted subjects.

Items 14 through 24 describe auditory sources of information in a transit environment. These were presented as soft audible signals or signs that talk with synthetic speech. Contrary to expectations, most sighted subjects rated this general category as having no influence. Of the remainder, auditory sources of information were rated as helpful, with very few at the low end of the scale. In each item, the majority of the visually impaired consumers supported the concepts of auditory information sources. Item 23, describing a talking sign to be activated by a hand-held device aimed by the user, received only 48% on the positive side. Perhaps the item was not understood by the respondents. The idea of aiming a device may add to the conspicuousness of the visually impaired traveller.

Items 25 to 28 probed signage graphics, fare card designs, and telephone information service. Both sample groups responded positively to these items.

The remainder of the items presented to the visually handicapped were designed to assess attitudes with respect to the importance of independent travel. Responses in this area were consistent with the practice philosophy in the fields of special education and rehabilitation. That is, visually impaired respondents did not deem it appropriate to have abundant physical assistance or to have modifications which would make them conspicuous as impaired travellers. They desired modifications which would enhance their

independent use of facilities available to the general public. Professionals in special education and rehabilitation of the visually impaired attempt to enable all students to reach their greatest potential for independent functioning in an environment which is not grossly altered for the sake of visually impaired persons.

The respondents' attitudes toward independence indicate that they were appropriate persons to evaluate the categories of solutions presented in the questionnaire. In general, then, reactions corroborated the findings and endorsed the conclusions of the principal investigators.

It is reassuring to note that none of the items suggested appeared to affect in a negative way the ease with which sighted travellers use rapid rail. In fact, the sighted appeared to find the modifications for the most part helpful in some degree.

B. Reactions of Transit Personnel

Input and feedback from the transit community were specifically solicited at two points in the project, regarding suggested techniques for improving communication with visually impaired travellers in rail rapid transit environments. First, when all the suggestions applicable to rail rapid transit in the literature of transportation and blindness had been collated by the principal investigators into a document entitled "Review of Existing and Proposed Modifications of Devices and Systems in Rail Rapid Transit Which Would Affect the Travel of Visually Impaired Persons" (Appendix I), this document was sent to all members of the project Liaison Network (listed in Appendix C). Members responded by mail and telephone, indicating additional suggestions they had encountered. These additional suggestions are included in the final version of "Review of Existing and Proposed Modifications of Devices and Systems in Rail Rapid Transit Which

Would Affect the Travel of Visually Impaired Persons", which appears in this report.

Second, a draft of the "Techniques for Improving Communication With Visually Impaired Travellers in Rail Rapid Transit Environments", Chapter 6, was reviewed and discussed at an invitational meeting for members of the transit community held on May 28, 1981 at Boston College. This document resulted from evaluation of suggestions taken from the "Review of Existing and Proposed Modifications of Devices and Systems in Rail Rapid Transit Which Would Affect the Travel of Visually Impaired Persons" by the principal investigators, in light of perceptual research, and from feedback from the survey described in part A of this chapter.

Participants in the meeting reviewing the draft of the "Techniques for Improving Communication With Visually Impaired Travellers in Rail Rapid Transit Environments" included eight representatives of authorities operating or constructing rail rapid transit systems in six cities in the eastern United States. They are listed below:

Calvin Turin
Division Engineer, Planning
New York City Transit Authority

Leonard Quinn
Supervisor of Passenger Services
Port Authority Trans-Hudson Corporation

Robert Corressel
Senior Planner for Special Services
Southeastern Pennsylvania Transportation Authority

John Sedlak
Manager of Architecture
Metropolitan Atlanta Rapid Transit Authority

Diane Ratcliff
Transportation Coordinator for the Elderly and Handicapped
Mass Transit Administration of Maryland

Cody Pfanstiehl
Director of Public Affairs
Washington Metropolitan Area Transit Authority

Don Kidston
Development Coordinator
Massachusetts Bay Transportation Authority

Tom O'Brien
Program Administrator
Special Needs Office
Massachusetts Bay Transportation Authority

All seven authorities represented had already implemented or were planning to implement one or more special features to aid the visually impaired. Among these features, being implemented or considered by one or more authorities, are tactile warning strips at platform edges, large print and tactile maps, architecture which facilitates orientation by the blind, fare payment machines with slots which are easy for visually impaired persons to identify and use, consistent placement of signs within stations, use of color codes on maps and within stations, and audible aids to locating vehicle doors.

Specific techniques for improving travel for the visually impaired that were discussed in detail were: textured warning strips; an audible aid to locating vehicle doors; and techniques for helping low vision travellers determine stairway dimensions.

As of the meeting date, all the authorities represented were attempting to come to grips with the Architectural and Transportation Barriers Compliance Board (Federal Register, January 16, 1981) and American National Standards Institute (1980) guidelines regarding the use of a textured warning strip at drops, especially along platform edges. Experiments have been conducted by several systems to find materials and techniques for creating warning strips which are durable, able to be installed and maintained at reasonable cost, and have sufficient visual and textural contrast to be readily detected by visually impaired travellers. Several materials and techniques are in use, and they vary in acceptability to visually impaired travellers, as well as in durability and costs of installation and maintenance. The strips vary in width and in distance from the platform edge.

It was obvious that there is great concern amongst transit authorities for more detailed specifications regarding textured warning strips. They are anxious that materials and techniques be described which are known

to produce warning strips which have good color and texture contrast, and which are durable and able to be installed and maintained at reasonable cost. They are also anxious to have exact descriptions of the placement and dimensions of warning strips.

These specifications can most appropriately be based on a combination of basic perceptual research, applied perceptual research in rail rapid transit environments, durability and maintenance tests in transit environments, and consultation with Special Needs Advisory Committees. The principal investigators strongly recommend that such research be conducted before further monies are allocated to the installation of textured warning strips.

A novel feature to be installed by the Mass Transit Administration of Baltimore, Maryland, is a "beeper" at the central door of each rail rapid transit vehicle. This device will emit a continuous beeping signal as long as the door is open. It is intended to aid blind persons in locating open vehicle doors.

This device has excellent potential for aiding visually impaired travellers. Its use by visually impaired travellers and acceptance by the general public need to be carefully monitored. It is possible that perceptual research coupled with technological development could specify sound emitters which would be easier for blind travellers to localize and which might also be more pleasing to non-handicapped travellers. The principal investigators also recommend that this research be conducted prior to installation of such devices in other systems.

Transit personnel varied in their response to the suggestion that stairways and escalators have nosings which contrast in color from treads and risers. Implementation of this suggestion would make it easier for low vision persons to judge the width of tread, height of risers, and

number of steps. The most durable material found for stairs is granite. Applied nosings were anticipated to be the most dangerous part of stairways. Nosings applied to concrete stairs have been found to wear out rapidly, becoming hazardous as they deteriorate. Better nosing materials and techniques are needed. It may be possible to stain granite to provide a durable, high contrast nosing.

Two alternatives to helping low vision travellers determine stairway dimensions were that lighting could enhance the contrast, and that painting stairwell walls a color which contrasts with stairways would facilitate judgement of depth of the stairway.

Other, more specific recommendations of rail rapid transit personnel have been included in either, or both, Chapter 6, "Techniques for Improving Communication With Visually Impaired Travellers in Rail Rapid Transit Environments", and Appendix I, "Review of Existing and Proposed Modifications of Devices and Designs in Rail Rapid Transit Which Would Affect the Travel of Visually Impaired Persons".

CHAPTER 6

TECHNIQUES FOR IMPROVING COMMUNICATION WITH VISUALLY IMPAIRED TRAVELLERS IN RAIL RAPID TRANSIT ENVIRONMENTS

A. Introduction

The techniques included in this chapter are based on an extensive review of transit and blindness literature related to rail rapid transit for the visually impaired (see Appendix I), on results of perceptual research summarized in Information about Visual Impairment for Architects and Transit Planners, (Vol. II of Improving Communications with the Visually Impaired in Rail Rapid Transit Systems), on informal and formal input and feedback from transit personnel and architects (described in Appendix B), and on reactions of potential consumers, both visually impaired and non-visually impaired (described in Chapter 5).

The principal investigators of this project are confident that implementation of the techniques described here will result in more safe, efficient and pleasant rail rapid transit use by visually impaired persons. Some of the techniques are described as concepts only, and specifications are not given for their implementation. Further technical development and empirical evaluation needs to be conducted before more specific recommendations can be made. Where such development and evaluation are especially necessary, this is mentioned in the report.

This chapter is divided into four sections. Section B distills techniques described in Appendix I into brief and manageable form, and relates these techniques to specific problems reported by visually impaired travellers in Boston, Philadelphia and Atlanta and to problems related by orientation and mobility specialists.

Section C is a composite of those parts of the GSA Accessibility Standard, October 14, 1980, which are currectly in effect which related to rail rapid transit architecture and which the principal investigators consider appropriate considerations in designing environments which are accessible for visually impaired travellers.

Section D describes, on a conceptual level, navigational aids which could potentially guide visually impaired persons from station entrances to fare card machines and/or the fare barrier, then to the platform, and from the train to the station exit. These concepts include an auditory pathway and a tactile/visual path.

B. Suggested Techniques

The information below is a side-by-side presentation of problems identified by visually impaired users of rail rapid transit and techniques which the principal investigators of this project conclude would enhance rail rapid transit use for visually impaired persons.

The process used to obtain information regarding problems of visually impaired travellers is described in Chapter 4. Some of the techniques have been suggested by another or many other sources concerned with accessibility. Readers who wish a more elaborate presentation of potential solutions or who desire documentation of sources of particular suggestions should refer to Appendix I.

The decision to implement a particular technique should be based on a detailed analysis of all the sources of information which will be available to visually impaired travellers at each decision point on a trip in each system. In conducting the type of analysis included in Appendix D, separate consideration is made of the information needs of totally blind and low vision travellers. The analysis will indicate that some systems will be found to

have signage and graphics which are well designed for low vision persons, but this same system might have none of the information sources which are particularly needed by totally blind travellers at some points on trips. Therefore such a system would particularly need to consider techniques for aiding totally blind travellers.

Each authority planning to implement techniques to aid visually impaired persons should also consult with its special needs advisory committee to be certain that the selected techniques address problems pertinent to that system and to visually impaired users of the system.

I. Access to Station	I.
A. Requirement: User must identify the station and locate the entrance.	A.
1. Problem: There was a lack of consistent signage or architectural clues which could be used to find the entrance to some stations.	1. Logos A large, well-lighted logo could be placed as consistently as possible in relation to each station entrance. Consistent placement is difficult to achieve because of general considerations such as directions of pedestrian approach and angles of clear viewing, which are also important to low vision persons. Placement of a smaller version of the logo directly over each entrance would help resolve this difficulty. If letters are at least 16" high, they can be read at 20' by persons having vision no greater than 20/800. This includes the vast majority of visually impaired travellers.
II. Accessibility Within Station	II.
A. Requirement: User must perceive and understand information about the correct platform, train, and direction.	A.
1. Problem: Some signs were located too high or in inconsistent locations.	1. Sign placement Signs could be in consistent locations throughout a system. For example, entrance/exits may all have two line signs immediately above them. The top line may give the station name and the bottom line may give additional information such as the name of the line, the direction of travel, or the location of the station within the city. Platforms may all have signs 10'- 20' from the platform edge, 8' high, and repeated every 25'. Signs intended to be read at a distance need to be above head level so they are not obscured by standing persons. If signs placed at 8' high are printed in 4" letters, they will be legible at 10' to travellers with 20/400 vision under ideal viewing conditions. (They are clean, well lighted,

	of high contrast, and of matte finish.) Signs placed higher need to be larger to achieve the same level of legibility.
2. Problem: Some signs were poorly lit, which hindered attempts to read them.	2. Sign lighting Signs should be well lighted internally or externally, either directly or indirectly, whichever is the most consistent with overall station design. Signs having external illumination will be adequately lighted for most low vision travellers if illumination at the surface is fifty footcandles. The lighting should be positioned to eliminate glare and so that shadows will not be cast by viewers in different positions.
3. Problem: Some signs were dirty and/or defaced.	3. Sign cleanliness Regular station maintenance should include attention to signs.
4. Problem: Some signs had low contrast between print and background.	4. Contrast on signs Signs which are white or light on black or dark backgrounds will have the greatest legibility.
5. Problem: Some signs, especially glossy baked enamel ones, were difficult to read because of glare.	5. Matte finish Matte finish signs are less effected by glare.
6. Problem: Some signs were written in small print only.	6. Print size Signs to be read at a distance should be in large print. The table which follows suggests the functions of signs at various distances for an individual with 10/200 vision.

Estimated Use and Visibility of Signage for an Individual with Vision No Greater Than 20/400

Minimum Size	Maximum Viewing Distance	Use of Information
8 in.	up to 20 feet	station entrances
6 in.	up to 15 feet	station name line name along platform and at station entrance
4 in.	up to 10 feet	train name (viewed from platform)
3 in.	up to 7.5 feet	line transfer information inside station
2 in.	up to 5 feet	route information on display maps

Though population estimates are extremely crude, this table would at least take into account the visual requirements of at least 70 percent of the visually handicapped population.

7. Problem:
There were no large print maps.

7(a) Print display maps

Print display maps can be designed, produced, mounted and illuminated so that a majority of low vision persons can obtain information from them.

(1) Letters should be no smaller than 18 pt. type. They should adhere to the proportions given in 1190.200(c).
(2) Colors should contrast with one another in brightness as well as hue. Most important information should be in white or light colors. A black or dark background is preferred.
(3) Maps should have a matte finish.
(4) Maps should be mounted vertically, and so that users can read them from as close as 2 in., if required by their visual condition.
(5) Maps may be illuminated internally. If they are illuminated externally, the lighting should be positioned to eliminate glare and prevent casting a shadow by viewers at varied distances.

	7(b) Distributed maps Low vision persons can utilize large type system and route maps. If display maps are well-designed for reading by low vision persons, these same graphics can be used to print maps on matte-finish paper for distribution.
8. Problem: The contrast between color codes was too low to be useful as a clue on some signs.	8. Color contrast The greatest apparent contrast between colors will be achieved by selection of colors on the basis of contrast in brightness as well as in hue.
9. Problem: Poor lighting made maps and large print signs less distinguishable.	9. Lighting for maps Maps will be adequately lighted for most low vision travellers if they are lighted in the same way as signs. (See II. A. 2 above)
B. Requirement: User must be able to pass through doors.	B.
1. Problem: Doors which opened outward and were in the path of travel were dangerous obstacles which could be walked into.	1. Door positions Hinged doors, while not in active use, should always be in a fully open or fully closed position for best detection by visually impaired travellers.
C. Requirement: User must approach fare barrier/ticket booth.	C.
1. Problem: There was no standard location of the entry gate or turnstile, which made it difficult to locate the appropriate gate.	1. Location of fare barrier/ticket booth In new systems, standardization of location of these facilities will enable visually impaired travellers to find them, independently and efficiently, without needing to learn their varied locations in each station.
2. Problem: There was no textured or otherwise tactually discernable path to gate, which could be consistently used.	2. Path to fare barrier/ticket booth Either an auditory pathway or a tactile/visual pathway can provide continuous in-station guidance to such facilities. Descriptions of these concepts can be found in Section D of this chapter.

3. Problem: There were narrow turnstiles which were difficult to pass through with dog guides.	3. <u>Accessible gates</u> Visually impaired travellers may be permitted to use gates intended primarily for passengers in wheelchairs.
4. Problem: There was no standard location for the information/change booth.	4. <u>Location of information/change booth</u> See II, C, 1 and 2.
5. Problem: There was a lack of distinction between entry and exit turnstiles in some places.	5. <u>Distinction between entry and exit turnstiles</u> Entry and exit turnstiles can be distinguished by low vision travellers using a system of red and green (or white) lights above the turnstiles or by large print signs approximately 8' above floor level.
6. Problem: The section of the "handicapped gate" on which the user was supposed to push when buzzer sounded was texturally unmarked, and the traveller pushed on the area adjacent to the gate rather than on the gate itself.	6. <u>Tactile marking on handicapped gate</u> The appropriate section of the handicapped gate may be smooth and the surrounding structure rough. This is consistent with the interpretation of a rough door knob or handle indicating the entrance to a hazardous area. (See Section C of this chapter for the GSA standard concerning tactile warning identification.) The visually impaired person can safely push on a smooth handle, but should not push on a rough one.
D. Requirement: The user must manipulate currency or show "proof of payment."	D.
1. Problem: There were farecard machines in which the farecard had to be inserted in a unique manner.	1. <u>Fare card design</u> Fare cards or passes should be so designed that a tactual clue facilitates correct orientation for insertion. See Figs. 1 and 2.
2. Problem: There were coin or token slots which had no contrast to the rest of the fare collection device, which made finding the slot a matter of trial and error.	2. <u>Slot design</u> Slots for coins or cards should have a high contrast corder, so they can be easily located by low vision travellers. Slots for coins or cards should have a raised border so they can be easily located by blind travellers. These borders should be so designed that they guide the coins or cards into correct position.

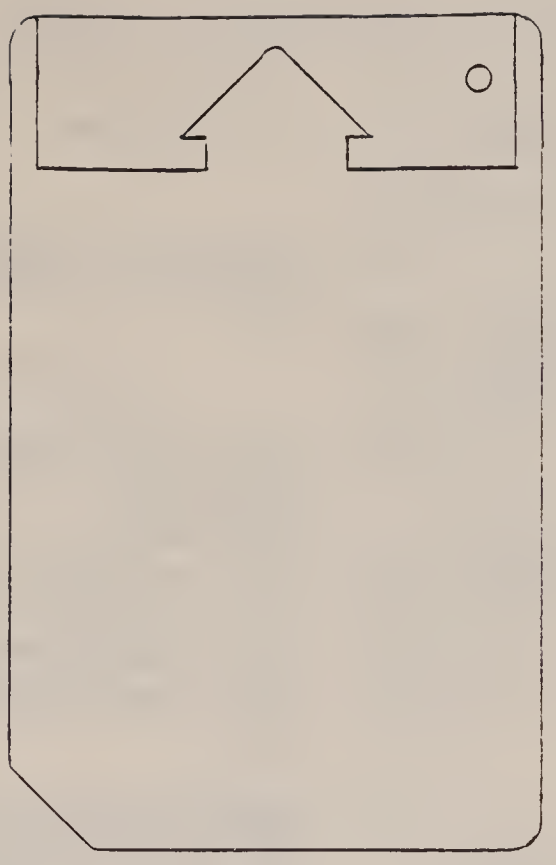
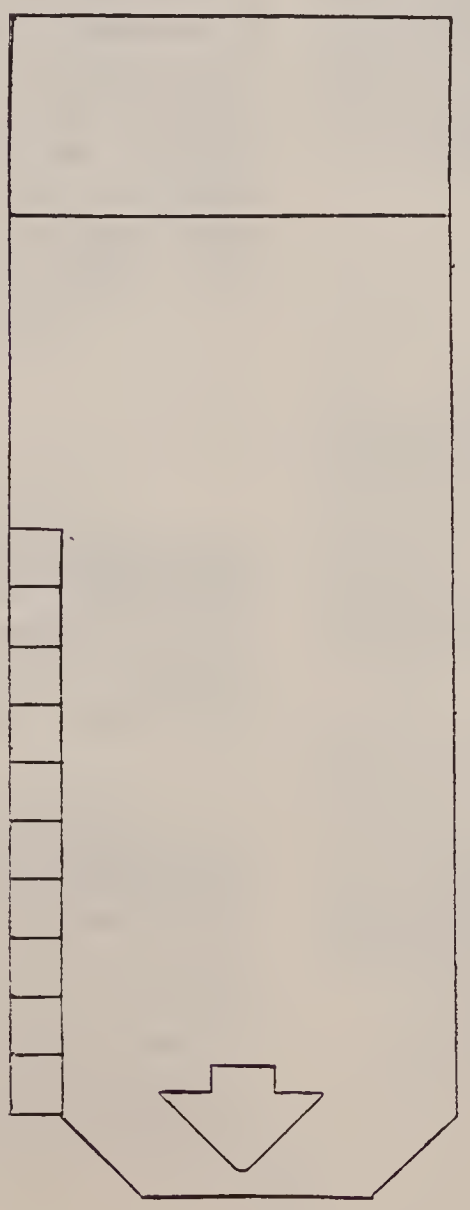


FIG. 1 FARE CARD, PATCO. THE DIAGONAL CORNER ENABLES TACTILE ORIENTATION.



ONE SQUARE IS CLIPPED OFF EACH TIME THE CARD IS INSERTED INTO THE VALIDATING MACHINE.

FIG. 2 FARE CARD, DANSKE STATSBANER. TACTILE ORIENTATION IS MADE POSSIBLE BY THE DIAGONAL CORNERS AND THE CLIPPED SQUARES.

3. Problem: Narrow money slots were the only passage for voice communication with attendants in some places, which made conversation very difficult.	3. <u>Facilitating voice communication with attendants</u> Communication can be facilitated by larger openings for voice communication or by additional head level openings.
E. Requirement: The user must travel along the platform to wait for the train.	E.
1. Problem: There were station platform edges marked with badly faded painted lines which were not sufficiently distinct from their adjacent area.	1.2.3 <u>Platform edge marking</u> Platform edges can be marked by warning strips along the entire length of the platform which differ from the floor of the platform in both color and texture. Appropriate colors, textures, and dimensions for such warning strips are currently under investigation.*
2. Problem: There were station platform edges without guardrails.	
3. Problem: There were station platform edges with textured strips which were not of sufficient contrast to the adjacent area so as to serve as tactile warnings.	
4. Problem: There were repaired areas of pavement which were re-surfaced with textured material that gave false clues.	4. <u>Repaired pavement</u> Pavement repairs should not contrast in texture with surrounding floor area.

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* This research is being conducted by John Templer, Georgia Institute of Technology; Billie Louise Bentzen and Alec F. Peck, Boston College.

F. Requirement:
The user must be able to avoid hazards.

1. Problem:
There were cracks and breaks in the pavement which could cause falls.

F.

1. Repaired pavement
Pavement cracks or breaks, especially those having a vertical discontinuity of ¼" or more, should be promptly repaired.

2. Problem:
There were litter baskets in potential travel paths.

2. Placement of litter baskets
Moveable litter baskets should be placed away from travel paths. Litter baskets which are fixed should ideally be recessed into walls or grouped with other station furnishings so they are not encountered and negotiated as separate obstacles.

3. Problem:
There were benches in potential travel paths where other travellers could be touched by canes, which places the traveller in an awkward social situation.

3. Placement of benches
Benches should be placed away from major travel paths. They should ideally be recessed into walls. They may also be grouped with other station furnishings so they are not encountered and negotiated as separate obstacles.

4. Problem:
There were newspaper and display racks in potential travel paths.

4. Placement of newspaper and display racks
Newspaper and display racks should be placed away from major travel paths. They may be mounted on walls or grouped with other station furnishings.

5. Problem:
There were poles and columns in potential travel paths.

5. Poles and columns
(a) Poles and columns are familiar and necessary supporting structures in some station designs. Removal of these supports is not feasible; however, injury resulting from bodily contact will be less where corners are rounded and where structural materials are somewhat resilient or encased by resilient materials to a height of 7'.
(b) Supporting columns can serve as helpful orientation clues, especially where they are located a consistent distance from the platform edge and if they are rectangular, with the long sides of the rectangle parallel with the platform edge or with the main flow of pedestrian traffic.

6. Problem: There were protruding telephone stations which did not project low enough to be detected by a cane.	6. <u>Design of protruding telephone stations</u> Telephone stations should protrude no more than 4", unless the protrusion has its leading edge at or below 27" above the floor. (See Section C of this chapter for the relevant GSA standard).
7. Problem: There were visual construction warnings which were attached to sawhorses located in potential travel paths.	7. <u>Placement of construction warnings</u> Sawhorses which must be used as construction warnings in potential travel paths should have horizontal braces no more than 27" from the floor so that they can be readily detected by a cane. All types of construction warnings should surround the danger at a minimum distance of 4' allowing the visually impaired traveller safely to take one full stride forward after physically encountering and perhaps displacing the warning barrier.
G. Requirement: The user must negotiate vertical movement.	G.
1. Problem: There were escalators which can be especially difficult to board and exit under stressful conditions.	1. <u>Alternative level changing facilities</u> Stairs and/or elevators should ideally be provided adjacent to all escalators.
2. Problem: There were handrails which did not project beyond the tops or bottoms of stairs.	2. <u>Handrail projections</u> Handrails should project beyond the top and bottom of all staircases in stations. (See Section C of this chapter, for the applicable GSA standard.)
3. Problem: There were cluttered and littered stairs.	3. <u>Cleaning stairs</u> Regular station maintenance should include attention to stairs.
4. Problem: There was no high contrast warning strip on some stair edges.	4. <u>Warning strips on stair edges</u> (a) Stair nosings which contrast in color from the riser and tread help low vision persons judge the extent and dimensions of stairways. (b) Where it is difficult to provide contrasting stair nosings, visual judgement of the extent and dimensions of stairways can be enhanced by having the wall along the stairway contrast in color and brightness from the surrounding wall.

5. Problem: Glare from windows was found on stairs, which may suddenly deprive travellers of visual clues.	5. Control of glare Glare on stairs can be minimized by illuminating stairways for their entire length by either artificial or natural light, not a combination of the two.
6. Problem: There was no clear visual or textural marking which clearly indicated the top step, which in some cases was the sidewalk.	6. Identification of top steps Especially where station entrances consist of small open shelters with stairs in line with pedestrian traffic along a sidewalk, and leading directly down, a warning to visually impaired persons should be provided by both a distinctive color band before the top step and a tactile warning.
7. Problem: There were breaks in handrails at landings, which caused confusion when staircases were unopposed.	7. Continuous handrails Continuous handrails at landings give visually impaired travellers information about the direction of stairs following landings. (See Section C of this chapter for the applicable GSA standard.)
8. Problem: There were greasy, filthy handrails which made use of the rail undesirable.	8. Clean handrails Routine maintenance should include attention to handrails.
H. Requirement: The user must identify the correct train.	H.
1. Problem: There were no train announcements (name or destination) in stations.	1. Train announcements in stations In-station announcements identifying arriving trains enable visually impaired travellers to independently identify an arriving train without being able to see a sign on the train or needing to ask fellow travellers to confirm the identification of the train.
2. Problem: There were trains which sat silently in stations, and they could not be recognized until their doors closed.	2. Train departure announcement Whenever feasible, the departure of a train should be announced a few seconds prior to departure. If personnel in the vicinity of the train are cognizant of the problem of visually impaired travellers, they can ensure that they are made aware of the waiting train.

I. Requirement: The user must observe and approach the train door area and enter the vehicle.	I.
1. Problem: The open doorway could not be quickly located.	1. Auditory beacon Chimes, bells, buzzers, or other sound generators could be located immediately above doors to signal their presence for blind travellers. The appropriate characteristics of such tones, however, should be locally determined prior to installation, since unique acoustical environments may effect their value.
2. Problem: There were open spaces between cars on trains which were mistaken for doors.	2. Gaps between vehicles Design of newer trains commonly eliminates this problem by providing some kind of framework which nearly fills this space and which is close enough to the platform edge to be readily contacted. Some older trains have been retrofitted with expansion gates which serve the same purpose.
3. Problem: The gap between the platform and train presented a stumbling hazard.	3. Platform/vehicle gap Several concepts for closing this gap have been presented elsewhere. See Vol.I "Solutions for Problems of Visually Impaired Users of Rail Rapid Transit," Appendix I. These are concepts only, and need to be developed and tested before their implementation can be recommended.
III. Access Within the Vehicle	III
A. Requirement: The user must identify a vacant seat.	A.
1. Problem: There were no designated seats on some trains, which should be designated near the door of the train.	1. Priority seating Designated seats for handicapped passengers should be provided in consistent positions near the doors of all trains.

B. Requirement: The user must move along the aisle, possibly during train movement, or must ride standing.	B.
1. Problem: Packages were placed in aisles by passengers, which were obstacles and which gave misleading clues.	1. Passenger awareness Public awareness of the difficulties visually impaired persons have perceiving and negotiating around low and unexpected obstacles will help alleviate this problem.
2. Problem: There was a lack of standard locations (among trains) of posts for grasping to maintain balance.	2. Location of stanchions Straps or handrails or posts for personal support should be provided immediately inside the door on board trains and at frequent and consistent intervals along the length of the inside of the car.
3. Problem: No auditory warning was given before the train accelerated or decelerated to a halt.	3. Auditory warnings If possible, auditory warnings in the form of verbal messages could be given on board trains immediately before acceleration to high speeds and immediately prior to rapid deceleration.
C. Requirement: The user must identify the desired stop or station.	C.
1. Problem: There were no station announcements on some trains.	1. On-board announcement of stations Clearly understandable announcements of the name of the next stop enables visually impaired travellers to prepare to exit vehicles efficiently.
2. Problem: There were no tactile maps available.	2. Tactile maps Tactile maps are a satisfactory means of supplying system and route information to totally blind travellers if they are available for distribution to these persons.

D. Requirement: The user must be able to exit the vehicle.	D.
1. Problem: There was no forewarning of the side of the car on which doors would open for exit.	1. Auditory signals (a) An auditory signal device such as a buzzer or bell, located immediately above each door which would open, and which was activated 3 to 5 seconds before a train door opened, would be of great value in localizing the correct exit and preparing to disembark. (b) Alternatively, where there is on-board announcement of stations, the announcement can include the side of the train on which doors will open.
IV Accessibility Upon Leaving the Station	IV
A. Requirement: The user must be able to exit the station.	A.
1. Problem: Some ends of platforms were not adequately blocked, and could be fallen off while other cues were being attended to.	1. Platform end barriers Ends of platforms should be physically blocked by barriers at least 2 to 3 feet in height, which cannot be upset or broken by accidental contact.
2. Problem: Some exit turnstiles were made of floor-to-ceiling horizontal bars, which were dangerous when in motion.	2. Accessible exits An accessible exit gate which can be passed through quickly and safely should be provided at all platform exits. GSA standards do not consider these exits made of floor-to-ceiling horizontal bars to be accessible. (See Section C of this chapter.)
3. Problem: Walls made of bars rather than being solid led to inappropriate auditory localizing, because of the irrelevant and confusing sounds from the other side of the barrier.	3. Solid walls Solid barriers provide auditory cues which are more easily used. Where see-through walls are desirable, the use of transparent solid materials such as glass or clear plastic is preferable to the use of bars or chain link fence.

4. Problem: There were "blind alleys" which were unmarked or only marked with visual signs.	4. Auditory or tactile path See Section D of this chapter for a description of the conceptual "Auditory Path" and "Tactile Path", either of which would be applicable to this problem.
V. Systemwide Problems of a General Nature	V.
1. Problem: Route information available by telephone was incomplete or was not informationally expanded for blind users (eg. number of stops between entry and exit stations was not available.)	1. Telephone information system A telephone information system which provided information on variables such as the number of stops between stations, the level on which entry and exit stations were located, and the location of transfer stops (where applicable) would be of great value to visually impaired persons.
2. Problem: Rest rooms were not available in some stations.	2. Rest room availability The availability of clean rest rooms is a great comfort to all travellers, especially in personal emergencies.
3. Problem: Rest rooms were locked and/or unmarked in some stations, and attendants who could open the door were difficult to find.	3. Rest room access Rest rooms which are marked with raised large print signs can be located by many visually impaired travellers. In situations where attendants must be located to unlock doors, instructions for locating the attendants could be available, in raised large print, on the door or immediately adjacent to it.
4. Problem: There were no raised letters or braille signs to identify such places as rest rooms.	4. Large print signs Where rest rooms are marked by signs, raised large print should be used. Braille signs offer another alternative for some blind persons.
5. Problem: There were no auditory cues to beckon travellers to safe exits in an emergency.	5. Auditory emergency exit indicators Speakers located immediately above station exits, which could broadcast messages such as "This is a safe exit" during an emergency, would be advantageous to all travellers under certain conditions (e.g. smoke-filled station).

C. GSA Accessibility Standards Relevant to Accessibility for Visually Impaired Travellers on Rail Rapid Transit

Transit authorities have been responsive to the needs and problems of many handicapped travellers for some time. Adherence to GSA Standards (or to ATBCB or ANSI standards) has solved some potential problems of visually impaired users of rail rapid transit in the three cities surveyed.

We are including here those sections of the GSA Accessibility Standard, Oct. 14, 1980, which pertain to increased accessibility for visually impaired persons in rail rapid transit. Because transit has been cognizant of these standards for some time, problems associated with failure to adhere to these standards were not necessarily reported in our data collection.

The principal investigators endorse the concepts contained in the following standards. They have not conducted research to validate specific dimensions contained in the GSA Standards, but know of no reason to believe the dimensions given are inappropriate.

5. BUILDINGS

5.1 RAMPS

5.1.7 Edge Protection. Ramps (with the exception of curb ramps) and landings with vertical drop-offs greater than 6" shall have curbs, walls, railings or projecting surfaces to prevent people from slipping off the ramp.

5.3 DOORS AND DOORWAYS

5.3.2 Revolving Doors and Turnstiles. Revolving doors and turnstiles are not considered accessible entrances. Accessible doors shall be located within 20 feet, or preferably, adjacent to either of these elements.

5.4 STAIRS

5.4.2 Treads and Risers. All steps on a single flight of stairs shall have uniform riser heights and uniform tread widths. Open riser stairs are not permitted.

5.4.4 Handrails. Continuous handrails shall be provided at both sides of all stairs.

Handrails shall extend a minimum of 12" on one side beyond the top riser and 12" plus the width of one tread on one side beyond the bottom riser. At the top, the 12" extension shall be parallel with the floor. At the bottom, the handrail shall continue to slope for a distance of one tread width from the bottom riser with the 12" remainder being horizontal and parallel with the floor.

5.4.5 Overhead Clearance. A protective barrier or warning signal shall be provided wherever an accessible path or space under a stairway has a headroom clearance less than 80".

5.8 PUBLIC TELEPHONES

5.8.3 Clearances. Telephones shall have an unobstructed floor approach space of at least 30" x 48".

Telephones, telephone enclosures, telephone booths and seats shall not reduce the minimum clear width of accessible paths of travel. (See also Section 5.13.2, "HAZARDS".)

5.9 ELEVATORS

5.9.1 * Elevators shall conform to the latest version of ANSI A17.1, "Safety Code for Elevators" and the "Suggested Minimum Passenger Elevator Requirements for the Handicapped" as developed by the National Elevator Industry, Inc. (Relevant portions of this latter document are included in this chapter following the relevant portions of the GSA Standards.)

5.11 SIGNAGE

5.11.1 General. Signage at entrances to accessible rooms and public spaces, specifically permanent room numbers and permanent space titles, shall comply with the criteria specified within this section.

5.11.2 Room/Facility Identification. Letters, numbers and symbols on signs shall be raised or incised 1/32" minimum, with sans serif characters and sharply defined edges. The characters shall be between 5/8" and 2" high with a width to height ratio of between 3:5 and 1:1. Indented Characters shall have a minimum stoke width of ¼" and be so proportioned so as to assure proper legibility (width to height ratio between 1:5 and 1:10).*

5.11.3 Location. Character identification shall be mounted at a height of 54" to 66" above the floor, and wherever possible, mounted on the wall at the latch side of the door.

5.11.4 Color Contrast. Characters shall contrast with their background, preferably light characters on a dark background.

5.11.6 Tactile Warning Identification. Doors leading into hazardous areas that might prove dangerous to a blind person shall be made quickly identifiable to the touch by knurling, roughening, or applying an abrasive coating to the surface of the door handle, knob, pull or other operating hardware.

Tactile warning indicators shall not be used to identify exit stairs.

5.12 FIRE ALARM SIGNALS

5.12.1 General. An audible fire alarm signal shall be provided in buildings which require fire alarm systems. Visual alarms are not required, except where an Occupant Emergency Organization plan has not been established to assure the safe evacuation of handicapped persons. Where visual alarms are needed, they shall be capable of simultaneous activation, and adequately meet the safety needs of all occupants whether visually or audibly handicapped.

* The principal investigators of this project do not consider incised characters sufficiently legible to be used for this purpose.

5.13 HAZARDS

5.13.1 Overhead Clearance. A minimum vertical clearance of 80" shall be provided above all accessible paths of travel.

5.13.2 Clear Width. Side protrustions under no circumstances shall reduce the minimum clear width of accessible paths of travel.

Side protrustions are restricted to 4", unless the protrustion has its leading edge at or below 27" above the finished floor/ground or is protected by wing walls or located within an alcove.

The following sections are taken from "Suggested Minimum Passenger Requirements for the Handicapped", which is Appendix "A" of GSA Accessibility Standard, October 14, 1980.

Suggested Minimum Passenger Elevator Requirements
for the Handicapped

7. CAR CONTROLS

Controls shall be readily accessible from a wheelchair upon entering an elevator.

The centerline of the alarm button and emergency stop switch shall be at a nominal (35) inches and the highest floor buttons no higher than (54) inches from the floor. Floor registration buttons, exclusive of border, shall be a minimum of (3/4) inch in size, raised, flush or recessed. Visual indication shall be provided to show each call registered and extinguished when call is answered. Depth of flush or recessed buttons when operated shall not exceed 3/8".

Markings shall be adjacent to the controls on a contrasting color background to the left of the controls. Letters or numbers shall be a minimum of (5/8) inch high and raised or recessed .030 inch.

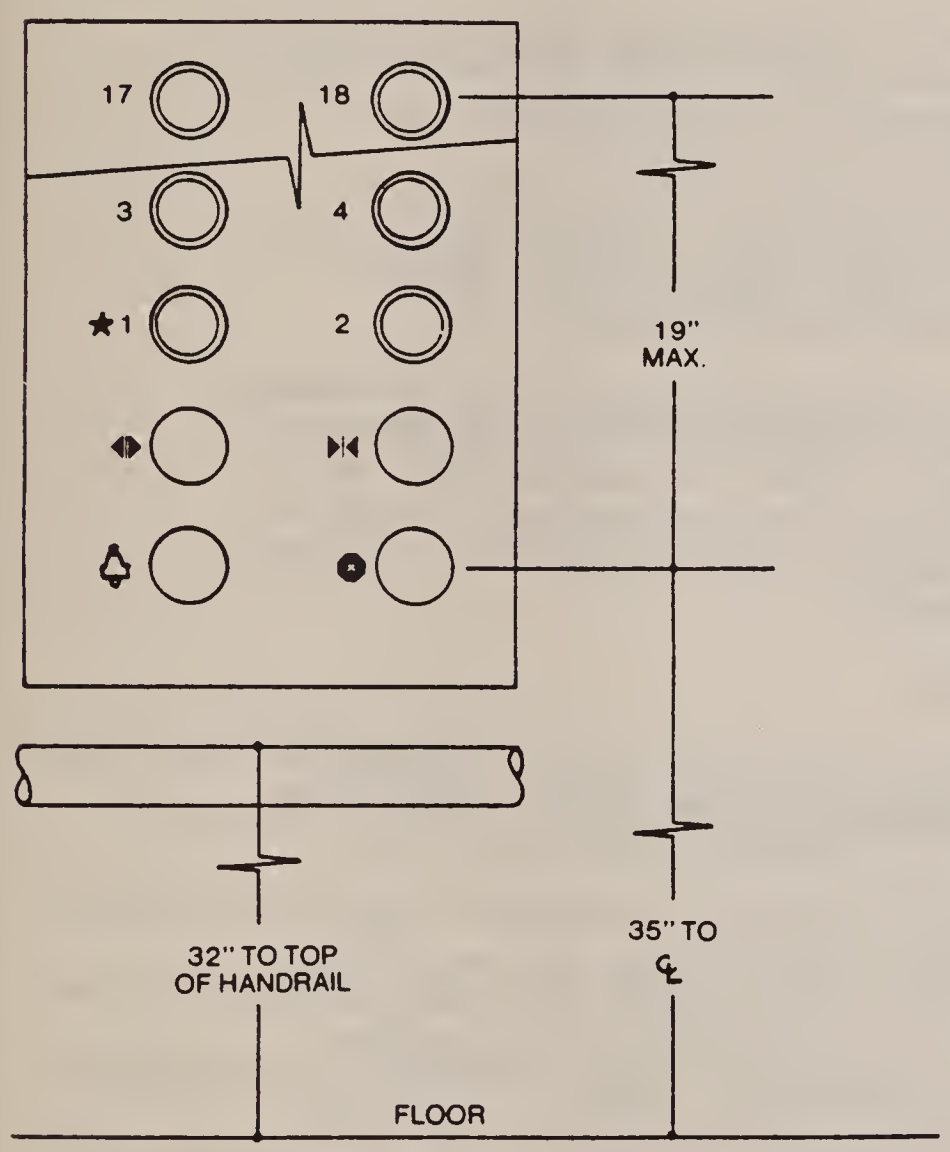
Applied plates permanently attached shall be acceptable.

Emergency controls shall be grouped together at the bottom of the control panel.

Symbols as indicated shall be used to assist in readily identifying essential controls.

Controls not essential to the automatic operation of the elevator may be located as convenient.

NOMINAL = ± 1 Inch.



CAR CONTROL SYMBOL DESIGNATION

DOOR OPEN

DOOR CLOSE

AUDIBLE SIGNALING DEVICE (ALARM)

EMERGENCY STOP SWITCH

Identify the main floor by use of the following symbol:

(Symbols shown are ⅝" actual size)

8. CAR POSITION INDICATOR & SIGNAL

A car position indicator shall be provided above the car operating panel or over the opening of each car to show the position of the car in the hoistway by illumination of the indication corresponding to the landing at which the car is stopped or passing.

indications shall be on a contrasting color background and a minimum of ½ inch in height.

In addition, an audible signal shall sound to tell a passenger that the car is stopping or passing a floor served by the elevator.

Special button located with emergency controls may be provided. Operation of button will activate audible signal only for desired trip.

9. TELEPHONE OR INTERCOMMUNICATING SYSTEM

A means to two-way communication shall be provided between the elevator and a point outside the hoistway in accordance with the requirements found in the latest edition of ANSI A17.1.

If a telephone is provided, it shall be located a maximum of (54) inches from the floor with a minimum cord length of (29) inches.

Markings or the international symbol for telephones shall be adjacent to the control on a contrasting color background. Letters or numbers shall be a minimum of (5/8) inch high and raised or recessed (.030) inch. Applied plates permanently attached shall be acceptable.

13. HALL BUTTONS

The centerline of the hall call buttons shall be a nominal 42 inches above the floor. The button designating the UP direction shall be on top.

Direction buttons, exclusive of border, shall be a minimum of (3/4) inch in size, raised, flush, or recessed. Visual indication shall be provided to show each call registered and extinguished when the call is answered. Depth of flush or recessed buttons when operated shall not exceed 3/8".

14. HALL LANTERN

A visual and audible signal shall be provided at each hoistway entrance indicating to the prospective passenger, the car answering the call and its direction of travel.

The visual signal for each direction shall be a minimum of 2½ inches in size and visible from the proximity of the hall call button.

The audible signal shall sound once (1) for the up direction and twice (2) for the down direction.

The centerline of the fixture shall be located a minimum of (6) feet from the floor.

The use of in-car lanterns conforming to above and located in jamb shall be acceptable.

15. DOOR JAMB MARKING

The floor designation shall be provided at each hoistway entrance on both sides of jamb visible from within the car and the elevator lobby at a height of (60) inches above the floor. Designations shall be on a contrasting color background (2) inches high and raised (.030) inch.

Applied plates permanently attached shall be acceptable.

D. Pathway Solutions

A ideal solution to many of the information gathering problems of the visually impaired in rapid rail systems would be a pathway which led them safely and efficiently from a station entrance, through the system, to a station exit. Although the authors know of no such pathway currently in existence in a rapid rail station, two such pathways are described, on the conceptual level, below.

1. Auditory Pathway

One solution to many of the problems encountered by visually impaired users of rail rapid transit would be the presence of a system of electronically-activated spoken messages which would guide the user through the rapid rail system. The user would carry a pocket-sized, lightweight device which would

be capable of activating units that played recorded messages (or synthetic speech) which presented route directions. These units would be located at various key locations within stations and on board trains, and would supply all necessary information for orientation of the traveller. Figure 3 depicts an artist's conception of such an "auditory pathway."

It should be noted that the auditory pathway would also be usable by other members of the elderly and handicapped population, including non-readers, mentally retarded citizens, and elderly citizens who become easily confused in transit stations. It could also be programmed in more than one language, enabling use by non-English speaking users.

2. Tactile Pathway

Another pathway which would be of value to visually impaired travellers would be a continuous textural path which was composed of material sufficiently distinct from the surrounding surface so as to be easily detected under foot or by cane. Such a path would begin at the station entrance, would pass through necessary turnstiles and/or gates, and would terminate at the platform. It would be marked by characteristics which distinguished it from a similar path which led from the platform to the exit.

Such a path could also be colored so as to have high visual contrast to the surrounding surface. This would be an aid to low vision persons whose residual vision was sufficient to allow them to visually follow the path.

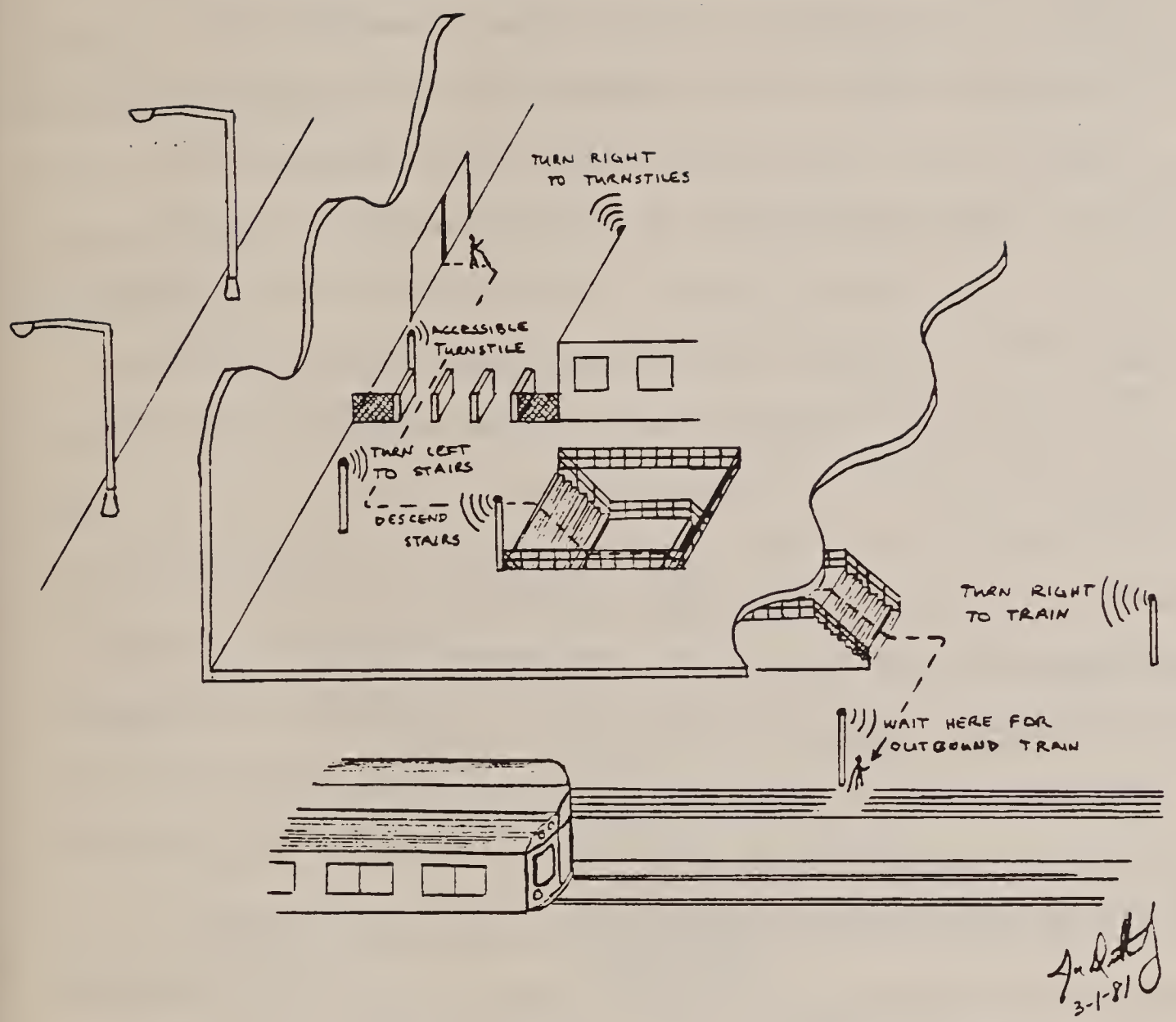


FIG.3 ARTIST'S CONCEPT OF AN AUDITORY PATHWAY IN A RAPID RAIL STATION.

CHAPTER 7

CONCLUDING REMARKS

A. Considerations in the Evaluation of the Proposed Suggestions

The suggested techniques contained in this document (see Chapter 3) should be evaluated in two major ways. First, it is recommended that experimental validation of each of the suggested techniques be carried out by researchers familiar with the problems and solutions discussed herein. Secondly, each rail rapid transit authority should independently review the suggestions with local advisory groups in order to determine the advisability and feasibility of implementing the suggestions in local existing facilities and in those being planned. Each of these evaluation activities will now be expanded upon.

1) Experimental validation - In some cases, suggestions are based on the authors' knowledge of principles of vision, and state-of-the-art knowledge about visual impairment. Examples of these are the suggestions for signage in transit environments and the color contrast modifications. The suggestions relative to each of these were based on laboratory studies in non-transit environments and/or anecdotal reports from field observers. On-site field testing must now be conducted in order to verify the advantages of the recommendations made.

In other cases, recommendations are based on the investigators' observations of prototype devices and structural modifications which appear to have the potential for aiding travellers in rapid rail environments, but which have never been implemented there. Examples of these are the tactile path and the auditory beacon. While each of these has undergone some testing in non-transit environments, further testing is necessary as well as field testing in rapid rail stations.

2) Validation by local transit authorities and advisory groups -
While all of the suggestions contained herein would aid visually impaired travellers, differences between rapid rail systems require local validation of the techniques. The age and unique aspects of each system suggest that priorities will differ from system to system. Systems can be analyzed for their existing accessibility to visually impaired travellers by use of the "The Visually Impaired Traveller Takes a Trip on Rail Rapid Transit; Decisions That Must Be Made; Sources of Information Available; Problems in Use" in Appendix D.

Existing plans for renovation and patterns of travel among the local visually impaired population will affect the priorities within each community. For example, a station which accesses a major eye clinic would be one which would be likely to service a large visually impaired population. If extensive renovations were being planned for such a station, then a review of these suggested techniques by the local blindness service system in conjunction with the local transit authority should lead to inclusion of as many of the techniques as are appropriate.

B. The Impact of Technology on the Mobility and Employability of the Visually Handicapped

Not until blinded veterans returned from World War II did rehabilitation services and specific training techniques emerge as a successful cohesive enterprise. Many political and social factors contributed to the initiation of blind rehabilitation but continuity in this field owes much to the impact of technology. Human factors engineering and high technology developments first stimulated by the defense industry and the so-called "space race" have dramatically expanded the communication and mobility capabilities of the visually impaired. Thus as the rehabilitation field was relentless in its cry to "hire the handicapped", the public became

more accepting as it witnessed the "miracles" performed by the blind with their amazing devices. Indeed, technology has played a major role in the success of rehabilitation.

The late John Dupress, former director of the MIT Sensory Aids Evaluation and Research Center, often stated that blind people need a means of getting about in the environment, access to the printed page, and a job. Blind and orthopedically handicapped from injuries sustained in World War II, Dupress knew full well that the possibility of gainful employment was dependent on one's accomplishments in mobility and communications. For this reason he dedicated his professional life to high technology solutions to those most practical problems.

Over the years many others have made original contributions to the sensory aids field. Some of the most successful technological achievements occurring during the last twenty years are described below.

Braille transcription is costly, time-consuming and requires very special knowledge of code: Moreover, few visually impaired individuals require a strictly tactile system of reading. For those that do, however, the available number of titles is strikingly low. For some time, blind and visually impaired individuals have been supplementing their reading requirements with audio-recorded material, either on tape or recorded disc. Classically, this mode has suffered from the user's inability to vary or accelerate the audio presentation. Techniques of time compression in which the audible message is shortened with loss of neither words nor speaker recognizability have been implemented in portable machines which dramatically improve access to written material.

Optical character recognition techniques have also been applied to the reading needs of the visually impaired. There are now direct conversion

machines which transform print into tactile images and/or synthetic speech. Requiring no human intermediaries, these machines have dramatically increased the volume of printed material available to the blind.

Electronic travel aids represent another category of devices that have appeared as a result of the new technology. Such devices are either obstacle detection instruments or complex environmental sensors (see "Considerations in the Design of Information Systems for Communicating with the Visually Impaired", in Volume 2 of Improving Communications with the Visually Impaired in Rail Rapid Transit Systems.) All have the property of providing the user with advanced information beyond what can be obtained with the long cane or residual vision. Returning echoes from ultrasonic signals or discontinuities in projected laser beams are converted to audible tones or tactile vibrations to furnish the user with the physical characteristics of distal space. Such devices may be hand-held, head-borne, worn on the chest, or installed in long canes. They require specialized training for optimal use and ultimately provide the user with an extended range of environmental information. They are customarily incorporated into or used in conjunction with more conventional travel aids, e.g., the long cane or a dog guide.

Though not yet in use in public facilities, custom integrated circuits capable of generating synthetic speech at low cost are appearing in the form of "talking signs". As described elsewhere in this report, such devices can be activated by a variety of means. They offer a distinct advantage in aiding the user to locate and identify landmarks or goals in a route of travel.

What is most significant about these technological advances is that they improve the quality of life for the visually impaired by fostering

safe, independent and efficient travel. Members of the transit community should not be surprised to observe the use of such devices in transit environments and should prepare personnel to understand their functions and limitations.

C. Need for Further Research

It has already been pointed out that one aspect of the evaluation of these techniques should be confirmation of their value through controlled experiments and field studies. However, it should also be noted that certain basic research in the fields of blindness, audition, and vision would be of great value in discovering other techniques (or modifications of techniques suggested herein) which would aid the visually impaired traveller.

One example of the need for such basic research is in the area of color contrasts. There is much which is still unknown about ideal intensities and hues when the problem is one of heightening contrast under various lighting conditions for the visually handicapped population.

Similarly, the ability to localize auditory signals emitted by bells, doors, crowds, and other complex sounds in a stressful transit environment, by an older population experiencing the gradual onset of hearing losses, is a phenomenon which has great need for controlled research.

Finally, it should be pointed out that the problems experienced by the blind and other elderly and handicapped groups in transit environments should be recognized by researchers and planners in the transit community itself. Research on the fundamental design and construction of stations and cars for maximum accessibility should result in improvements in rail rapid transit for all users.

APPENDIX A

A GLOSSARY OF DEFINITIONS RELATED TO VISUAL IMPAIRMENT

Introduction

This report contains a 107-item glossary of definitions related to visual impairment, which can be used by transit personnel in communications and publications referring to visually impaired individuals. The items have been selected on the basis of relevance to issues of interest for transit personnel. The definitions have been selected either from existing works on the basis of accuracy, or written specifically for this glossary. Those definitions which have been taken from other works are followed by a number which corresponds to a reference listed below.

1. Allen, W., Griffith, A., and Shaw, C. Orientation and mobility. New York: New York Infirmary/Center for Independent Living, 1977.

2. Efron, M. Who is the visually impaired child? Boulder, Colorado: Social Science Education Consortium, Inc., 1979.

3. Hill, E., & Ponder, P. Orientation and mobility techniques. New York: American Foundation for the Blind, 1976.

4. Napier, G., Kappan, D., Tuttle, D., Schrotberger, W., & Dennison, A. Handbook for teachers of the visually handicapped. Louisville: American Printing House for the Blind, 1974.

5. Peripatology manual. Boston College Division of Special Education and Rehabilitation, 1980.

Glossary

ACCOMMODATION - The adjustment of the eye for seeing at different distances, accomplished by changing the shape of the Crystalline lens through action of the ciliary muscle, thus focusing a clear image on the retina. (4)

ALBINISM - An hereditary loss of pigment in the iris, skin, and hair; usually associated with lowered visual acuity, nystagmus and photophobia and often accompanied by refractive errors. (4)

ALIGNING (ALIGNMENT) - The act of establishing a line of travel parallel to a direction indicator such as a wall or moving sound such as a subway vehicle in order to facilitate maintenance of straight line of travel.

AMBLYOPIA - Dimness of vision without any apparent disease of the eye. (4)

APHAKIA - Absence of the lens of the eye. (4)

ARC - The path of the cane tip as the cane is moved in the touch cane technique. (1)

ASTIGMATISM - Refractive error which prevents the light rays from coming to a single focus on the retina because of different degrees of refraction in the various meridians of the eye. (4)

AUDITION - The process of relating to or experiencing through hearing. (3)

AUDITORY - Related to or experienced through the sense of hearing. (3)

BINAURAL - Hearing with, of, relating to, or used with both ears. (5)

BINOCULAR VISION - The ability to use the two eyes simultaneously to focus on the same object and to fuse the two images into a single image which gives a correct interpretation of the object's solidity and position in space. (2)

BLINDNESS - In the United States, the legal definition of blindness is: central visual acuity of 20/200 or less in the better eye after correction; or visual acuity of more than 20/200 if there is a field defect in which the widest diameter of the visual field subtends an angle distance no greater than 20 degrees. (4) A person who at a distance of 20 feet can clearly distinguish only the largest (top) E from the Snellen eye chart would be given the visual acuity of 20/200. A "normally" sighted person would be able to distinguish only the largest E at a distance of 200 feet. A person with a visual field restricted to 20 degrees could only see the area of a 10 inch dinner plate at a distance of 29 inches without shifting his gaze.

BODY IMAGE (AWARENESS) - An individual's conceptualization of the size, shape, function, and movement of his body parts and of their relationship to each other.

BUMPER PROTECTION - Frontal protection offered by techniques which keep an arm(s) or cane in front of the body, e.g., protective techniques and diagonal cane techniques. (1)

CANE - see LONG CANE.

CATARACT - A condition in which the Crystalline lens of the eye, or its capsule, or both become opaque. (4)

CENTRAL VISUAL ACUITY - Ability of the eye to perceive the shape of objects in the direct line of vision. (4)

CLEAR (CLEARING) - The process of confirming the safety of an area either with a sweep of the cane tip on the ground or with a sweep of the hand on the surface. (3)

CLUE - Any sensory information (sound, odor, temperature, tactile, or visual stimulus) which assists the person in identifying objects or in determining position or line of direction. A clue is most useful when it is position or line of direction. A clue is most useful when it is permanent, constant, recognizable and accessible.

COLOR DEFICIENCY - Diminished ability to perceive differences in color - usually for red or green, rarely for blue or yellow. (4)

CONGENITAL - Present at birth. (4)

CONVERGENCE - The process of directing the visual axes of the two eyes to a near point, with the result that the pupils of the two eyes are closer together. The eyes are turned inward. (4)

CUE - Any sound, odor, thermal, tactile or visual stimulus affecting the senses which will elicit an immediate or automatic response. (3)

CUTANEOUS SENSORY INFORMATION - A composite of sensory information arising from receptors in the skin, especially tactual (touch) and thermal (temperature) sensory information. (5)

DARK ADAPTATION - The ability of the retina and pupil to adjust to a dim light. (4)

DEPTH PERCEPTION - One's determination of the distance of an object from himself using visual clues.

DIAGONAL CANE TECHNIQUE - Use of a cane to provide frontal bumper protection. The cane is held diagonally across the lower half of the body. (1) It does not protect the user from low obstacles on the side opposite the cane tip, nor from obstacles above the waist.

DIPLOPIA - The seeing of one object as two. (4)

DIRECTION INDICATOR - Any environmental sensory information which is utilized to establish a line of travel and/or is utilized as a reference point. (5)

DOG GUIDE - Specially trained dogs useable by a small percentage of the blind population as an aid in avoiding hazards and locating landmarks.

DYSLEXIA - Inability to read which is apparently due to a neurological problem.

ECHOLOCATION - The technique of locating objects by emitting sounds and interpreting the echos (e.g., a blind person may walk parallel to a wall by interpreting the echos of his footsteps).

ELECTRONIC TRAVEL AID - Electronic devices which assist the blind traveller in locating or identifying landmarks and finding a clear path of travel. All current varieties are usually in conjunction with a long cane.

EYE DOMINANCE - The tendency of one eye to assume the major function of seeing, being assisted by the less dominant eye. (4)

FACIAL VISION - The term applied to the once widely held belief that objects could be perceived through skin sensations. (See OBJECT PERCEPTION - 5.)

FAMILIARIZATION (FAMILIARIZE) - The process of learning the spatial characteristics of an environment and the locations of objects within that environment through a series of systematic sensory inputs and experiences.

FIELD OF VISION - The entire area which can be seen without shifting the gaze. (4)

FLOATERS - Small particles consisting of cells or fibrin which move in the vitreous. (4)

FOCUS - Point to which rays are converged after passing through a lens; focal distance is the distance rays travel after refraction before focus is reached. (4)

FUSION - The power of coordinating the images received by the two eyes into a single mental image. (4)

GUIDELINE - The border between two surfaces such as the junction of a paved and a non-paved area. A guidelines can be detected and followed with a long cane.

HANDTRAIL - To follow a parallel surface by constant contact with either hand. (1)

HAPTIC PERCEPTION - Perception yielding spatial judgements of size, shape, location, etc. arising from a composite of tactual and proprioceptive sensory information. (5)

HEMIANOPSIA - Blindness of one-half the field of vision of one or both eyes. (4)

HYPEROPIA - A refractive error in which, because the eyeball is short or the refractive power of the lens weak, the point of focus for rays of light from distant objects (parallel light rays) is behind the retina; thus, accommodation to increase the refractive power of the lens is necessary for distant as well as near vision. (4)

JAEGER TEST - A test for near vision; lines of reading matter printed in a series of various sizes of type. (4)

LANDMARK OR PRIMARY CLUE - A familiar, permanent, constant, recognizable, accessible clue which indicates spatial relationships; used as an orientation check along a route.

LIGHT PERCEPTION - The visual ability to detect the presence or absence of light.

LIGHT PROJECTION - The visual ability to detect light and determine the direction of the light source.

LINE OF TRAVEL - The course along which a person is moving. (3)

LOCALIZE - The process of determining the relationship in space between oneself and an object(s) using the available sensory information.

LONG CANE - A lightweight cane of prescribed length which is an obstacle detector and environmental sensor for the blind pedestrian. They are typically white, with a six inch red stripe above the lower tip, and are longer than an orthopedic cane.

LOW VISION - When impairment in the visual system interferes with normal daily functioning.

LOW VISION AIDS - Optical devices of various types useful to persons with vision impairment. (2)

LOWER ARM PROTECTION TECHNIQUE - A technique which uses the forearm to protect the traveller's midline body at groin or upper thigh level while the person is walking.

MASKING SOUND - A sound which interferes with the reception of or blocks out a desired sound. (5)

MOBILITY - The process of moving from one's present position to a desired locale safely and effectively with and/or without the use of a travel aid.

MOBILITY INSTRUCTOR - Any professionally trained orientation and mobility teacher, specialist or peripatologist. (1)

MYOPIA (NEARSIGHTEDNESS) - A refractive error in which, because the eyeball is too long in relation to its focusing power, the point of focus for rays of light from distant objects (parallel light rays) is in front of the retina. Thus, to obtain distinct vision, the object must be brought nearer to take advantage of divergent light rays (those from objects less than 20 feet away).

NEGOTIATE - To travel around an object in one's line of direction while remaining oriented to one's environment. (1)

NYSTAGMUS - An involuntary, rapid movement of the eyeball, which may be lateral, vertical, rotary, or mixed. (4)

OBJECT PERCEPTION - The process of determining the presence of an object in one's path through use of reflected auditory information. This process has historically been referred to as "Facial Vision" and incorrectly attributed to the development of a sixth sense in the skin of blind persons.

OCULIST (OPHTHALMOLOGIST) - A physician who is licensed to practice medicine and surgery and who specializes in diagnosis and treatment of defects and diseases of the eye. (4)

OCULUS DEXTER (O.D.) - Term denoting the right eye.

OCULUS SINISTER (O.S.) - Term denoting the left eye.

OCULUS UTERQUE (O.U.) - Term denoting both eyes.

OPHTHALMOSCOPE - An instrument used in examining the interior of the eye. (4)

OPTIC ATROPHY - Degeneration of the nerve tissue which carries messages from the retina to the brain. (4)

OPTICIAN - One who grinds lenses, fits them into frames, and adjusts the frames to the wearer. (4)

OPTOMETRIST - A licensed, nonmedical practitioner who measures refractive errors and eye muscle disturbance. In treatment the optometrist uses glasses, prisms, and exercises only. The letters O.D. follow the name. (4)

ORIENTATION - The process of utilizing the remaining senses in establishing one's position and relationship to all other significant objects in one's environment. (3)

ORTHOPTIC TRAINING - A series of scientifically planned exercises for developing or restoring the normal teamwork of the eyes. (4)

PARALLELING - The utilization of auditory or visual sensory information to establish and maintain a line of travel parallel to the source of sensory information. (5)

PARTIALLY SIGHTED - A person whose best corrected visual acuity in the better eye does not exceed 20/70 but is better than 20/200.

PERIPATOLOGY - The art and science of aiding a blind or visually handicapped invididual to move about her/his environment safely, effectively and with confidence. (5)

PERIPHERAL VISION - The ability to perceive the presence, motion, or color of objects outside of the direct line of vision. (5)

PHOTOPHOBIA - Abnormal sensitivity to and discomfort from light. (5)

PRESBYOPIA - A gradual lessening of the power of accommodation due to physiological change which becomes noticeable after the age of forty. (5)

PROTECTIVE TECHNIQUES - The use of the body or an aid to protect the individual from encountering potentially dangerous obstacles (including protruding objects, fire hydrants, stairs, potholes, etc.).

PSEUDOISOCHROMATIC CHARTS - Charts with colored dots of various hues and shades indicating numbers, letters, or patterns, used for testing color discrimination. (4)

REACTION DISTANCE - The actual space between the visually handicapped individual and an object detected through use of a protective system (body or cane).

REACTION TIME - The time equivalent of the reaction distance. (1)

REFRACTION - 1) The deviation in the course of the rays of light in passing from one transparent medium into another of a different density. 2) The determination of refractive errors of the eye and correction by glasses. (4)

REFRACTIVE ERROR - A defect in the eye that prevents light rays from being brought to a single focus exactly on the retina. (4)

RETINITIS PIGMENTOSA - (Primary Pigmentary Degeneration) Hereditary degeneration and atrophy of the retina. There is usually misplaced pigment. (4)

SCANNING - Systematic search of the sensory array in one's environment for the desired sensory information.

SCOTOMA - A blind or partially blind area in the visual field. (4)

SIGHTED GUIDE TECHNIQUE - The use of a sighted person as an aid for travelling. The visually handicapped person grasps his guide's arm just above the elbow with a firm yet relaxed grip, and follows about a half step behind the guide. This allows sufficient time to react to the guide's starting, stopping, turning or stepping up or down.

SOLICITING AID - The act of requesting assistance from a sighted person in order to reach a destination or overcome a temporary situation such as auditory confusion, an uncontrolled intersection or unfamiliar territory.

SOUND MASKING - See MASKING SOUND.

SOUND SHADOW - A change in sound created when there is an object between a sound source and the perceiver. (5)

SPATIAL ORIENTATION - The act of establishing environmental interrelationships (i.e., between self, others, objects) within a context of a reference system. This implies a functional body schema, awareness of objects, effective perceptual-motor behavior and appropriate concept functioning (e.g., location, direction distance, shape, etc.). (5)

SNELLEN CHART - A display used for testing central visual acuity. It consists of lines of letters, numbers, or symbols in graded sizes drawn to Snellen measurements. Each size is labeled with the distance at which it can be read by the normal eye. Most often used for testing vision at a distance of 20 feet. (4)

SQUARING OFF - The act of establishing a line of travel perpendicular to a direction indicator.

STEREOSCOPIC VISION - The ability to perceive relative position of objects in space without such cues as shadow, size, and overlapping. (4)

STRABISMUS (CROSS EYE) - The failure of the two eyes simultaneously to direct their gaze at the same object because of muscle imbalance. (4)

SYMPATHETIC OPHTHALMIA - An inflammation of one eye due to an infection in the other eye. (4)

TACTILE - Characteristics of objects which are perceivable by active or passive touch. (5)

TACTUAL SENSORY INFORMATION - Sensory information arising from receptors in the skin stimulated by active or passive touch (see Cutaneous Sensory Information).

TANGENT SCREEN - A large black or gray curtain supported by a framework on which the normal central field and blind spot have been lightly outlined. This instrument is used for measuring the central field of vision. (4)

TIME/DISTANCE JUDGEMENT - The utilization of proprioceptive sensory information to estimate distance travelled or time spent travelling. (5)

TONOMETER - An instrument for measuring pressure inside the eye, called intra-ocular pressure. (4)

TRACING - The use of visual or haptic sensory information to follow the outline of an object.

TRACKING - The use of visual or auditory information to follow the path of a moving object or objects.

TRAILING - The act of following a surface visually, by hand or by cane in order to determine one's position in space, locate a specific objective or establish a parallel line of travel.

TUNNEL VISION - Contraction of the visual field giving the affected individual the impression of looking through a tunnel. (4)

UPPER HAND AND FOREARM PROTECTIVE TECHNIQUE - The positioning of the hand and forearm in a horizontal position in front of the body at shoulder height, with the palm forward, fingers extended, together and relaxed.

APPENDIX B

PROJECT ADVISORY COMMITTEE

The project was guided, especially through the stages of identification of problems and of beginning to identify solutions to these problems, by an Advisory Committee. The members of this committee served on a voluntary basis, and contributed to the project both through formal and informal consultation. They met, as a group, with the project staff on December 1,1980, to review and comment upon the problems identified through five other sources of data, and they suggested solutions to many of these problems.

The members of the group had previously served on the Subcommittee on the Visually Impaired of the Special Needs Advisory Committee for the Massachusetts Bay Transportation Authority. They are listed below.

Cafer Barkus	Perkins School for the Blind, Instructor Consumer - totally blind; travels with aid of a long cane
Rachel Victoria Berg	Orientation and Mobility Specialist
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Robert Gordon	Disabled Students of Northeastern University, Member Consumer - low vision
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Diana Morreo	Consumer - low vision
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APPENDIX C

PROJECT LIAISON NETWORK

A Liaison Network was formed during the initial phase of the project to aid the project staff in the following ways.

1) To provide information about problems of visually impaired users of rail rapid transit, from both the transit and the blindness perspective.

2) To provide information about particular solutions or concepts for solutions of problems mentioned.

3) To review and add to the "Review of Existing and Proposed Modifications of Devices and Systems in Rail Rapid Transit Which Would Affect the Travel of Visually Impaired Persons" (Appendix I), to insure its completeness and accuracy.

4) To review and provide feedback on a draft of the "Techniques for Improving Communication with Visually Impaired Travellers in Rail Rapid Transit Environments".

5) To serve as an informal information exchange link between the project and the organizations and professional groups which they represent.

The membership was comprised of transportation personnel, university faculty involved in personnel preparation in the area of the visually handicapped, national consultants on blindness, and members of the American Association of Workers for the Blind--Interest Group 9: Architectural and Environmental Concerns Committee.

The members are listed on the following pages.

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APPENDIX D

THE VISUALLY IMPAIRED TRAVELLER TAKES A TRIP ON RAIL RAPID TRANSIT; DECISIONS THAT MUST BE MADE; SOURCES OF INFORMATION AVAILABLE; PROBLEMS IN USE

The following table (Table D-1) summarizes the findings of the analysis of the decisions visually impaired travellers must make while negotiating rail rapid transit. The procedure for obtaining this information is described in Chapter 3, "The Concept of the Trip: The Sequence of Decisions Visually Impaired Travellers Must Make While Negotiating Rail Rapid Transit".

This table can be used to help determine how accessible a particular system or station is to visually impaired travellers. In addition to listing, in order, all the decisions visually impaired travellers must make, the table relates all the redundant information sources which transit often makes available to all travellers. It indicates which of these sources is useful, and the extent to which each is useful to totally blind travellers and to low vision travellers. It then describes the problems in existing information sources which limit their usefulness to the visually impaired.

The table can thus be used as a guide, step by step, through any trip on any system, to help determine the relative accessibility of that trip for visually impaired travellers.

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
I. Obtaining route information					
A. How would you find out what line to travel on, and at which stations to get on and off?	A. 1. Print a. Maps-large type, wall-mounted b. small-type, distributed	A. 1. No	A. 1. a. Sometimes	A. 1. a. Poor lighting, poor contrast, smooth (glare) surface b. Scale and print too small; poor contrast c. None available	A. 1. a. Extremely high contrast in natural light versus shadow in ground level and above ground level stations exaggerate the problems of lighting, contrast, and glare
	2. Telephone information system	2. Yes	2. Yes	2. Frequently busy for long periods of time	2. No difference

*The descriptors in this column are as follows:

No=source never useful
Rarely=source useful 5-10% of time
Occasionally=source useful 10=40% of time
Sometimes=source useful 40-60% of time
Usually=source useful 60-85% of time
Yes=source useful 85% of time or more

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
II. Locating the station					
A. How will you find the station?	A. 1. Print street maps a. Wall-mounted b. Small-type, distributed	A. 1. No	A. 1. a. Sometimes	A. 1. See I.A. 1, a,b, & c, about poor lighting, scale, and availability.	A. 1. See I.A.i.a, about lighting contrasts.
	2. Telephone information system	2. Yes	2. Yes	2. May not know precise location of station in terms meaningful to visually handicapped traveller (e.g., entrance to the Red Line at Park Station, which is nearest to 110 Tremont St., is N. of the N.E corner of the intersection of Tremont and Park. The opening of the entrance is perpendicular to Tremont Street on the N. end of the small enclosure.	2. No difference
	3. On arrival in area station is visible through signs and characteristic architecture	3. No	3. Sometimes	3. a. Signs are poor in contrast and illumination b. Architecture varies greatly within a system	3. a. See I.A.1. a, about lighting contrasts. b. Stations at ground level and above may present larger visual tar- "targets" for low vision travellers c. Stations at ground level and above may be readily located by auditory information of rail vehicles stopping and starting

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
III. Locating the entrance					
A. How will you find the entrance to the station?	A. 1. On arrival, entrance is visibly recognizable a. Lighting contrasts from surroundings b. Discontinuities in graphic designs	A. 1. No	A. 1. Sometimes	A. 1. a. Entrances not labelled as such b. Glass doors not visible because they are not marked at eye level. c. Doors not visually contrasting from their surrounding	A. No differences
	2. Distinctive architecture recognizable by touch	2. Sometimes	2. Sometimes	2. Tactual difference from surrounding enclosure may be minimal.	
	3. When doors are open, smell, change in temperature, change in air currents, sounds of turnstiles or transit vehicles	3. Yes	3. Yes	3. Doors are not always open.	
	4. Movement of other passengers	4. Yes	4. Yes	4. There are not always passengers using the entrance at the same time.	

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
IV. Locating and negotiating stairs (escalator or elevator)					
A. How do you know in what direction the stairs are from the entrance?	A. 1. Characteristic visible architecture	A. 1. No	A. 1. Sometimes	A. 1. a. Poor lighting and contrast make stairs less visible than they otherwise can be. b. Some construction details (i.e. open risers) may be visually confusing and physically hazardous.	A. 1. a. Strong differences in light intensity, as may be found in ground level or a above ground level stations make architectural details more difficult to discern. b. Sunlight filtering through open risers forms visually confusing patterns and may make it difficult for low vision travellers to determine the relevant architectural information such as height of riser, depth of tread, a and location of handrail.
	2. Change in elevation	2. Yes	2. Yes	2. a. While detectable by a capable, alert blind traveller, using an aid such as a long	2. a. No differences

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
IV. (cont.)				cane or some electronic aids, and having no additional impairment such as peripheral neuropathy, not all totally blind travellers can recognize and respond to drops before risking a fall. b. Open risers make it more difficult to maintain orientation to the staircase. c. Open risers can make a dropped cane irretrievable to the unaided blind traveller	
	3. Other pedestrians	3. Yes	3. Yes	3. Other pedestrians may not be present.	3. No differences
	4. Sound and/or vibration of escalator or elevator	4. Yes	4. Yes	4. a. High intensity ambient noise, and use of acoustically absorbent materials may make it difficult to hear the characteristic sounds.	4. Wind, rain or snow can dampen, distort, and dislocate sound from an escalator or elevator.

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
IV. (cont.)	5. Smell, change in temperature, change in air currents, sounds of turnstiles or transit vehicles	5. Yes	5. Yes	5. None of these is <u>always</u> present, although they can be excellent clues, especially in familiar locations.	5. No differences
B. How will you locate the first riser?	B. 1. Characteristic visible architecture	B. 1. No	B. 1. Sometimes	B. 1. a. Poor lighting and contrast makes stairs less visible than they otherwise can be.	B. See IV.A.1.a, concerning varying levels of light intensity.
	2. Obstacle or drop at floor level, which exploration reveals to be a riser.	2. Usually	2. Yes	2. See IV.A.2.a, concerning difficulties in recognizing drops.	
C. How will you know whether the stairs, escalator, or elevator go up, or down?	C. 1. Characteristic visible architecture	C. 1. No	C. 1. Usually	C. 1. Poor lighting and contrast make stairwells less visible.	C. See IV.A.1.a, concerning varying levels of light intensity.
	2. Obstacle or drop at floor level	2. Yes	2. Yes	2. See IV.A.2.a, concerning difficulties in recognizing drops.	

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
IV. (cont.)	3. Inference (e.g., "I'm entering the subway station at ground level. Therefore, I know I must go down."	3. Yes	3. Yes	3. Some lines which are primarily tunneled have occasional surface or elevated stations, making inference uncertain.	
	4. Pedestrians ascending or descending.	4. Yes	4. Yes	4. Not always present.	
D. How will you find the handrail, if you use it?	D. 1. Characteristic visible architecture	D. 1. No	D. 1. Sometimes	D. 1. Poor lighting and poor contrast between handrail and surrounding area make handrail hard to see.	D, No differences
	2. Physical presence of the handrail	2. Usually	2. Yes	2. a. Inconsistent placement of handrails and changes in handrail characteristics make it difficult to anticipate the location of handrails. b. Discontinuous handrails must be relocated after each landing. They also provide no orientational clues to presence or absence of turns on a stairway.	

(continued)

DECISIONS (in Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
V. Locating and negotiating fare collection area.					
A. How do you know in what direction the fare collection point is from the entrance?	A. 1. Characteristic visible architecture	A. 1. No	A. 1. Sometimes	A. 1. a. Poor lighting and contrast make the area hard to localize. b. Inconsistencies within and between lines and systems makes anticipation of characteristic visual patterns unreliable.	A. 1. a. See IV. A.1.a, concerning differences in light intensity.
	2. Sounds of fare collection devices	2. Yes	2. Yes	2. a. Characteristic sounds may be at a frequency and intensity which makes them difficult to hear or localize.	2. Wind, rain, or snow can dampen and dislocate characteristic sounds from fare collection devices.
	3. Other travellers	3. Sometimes	3. Sometimes	3. Not always present	3. At ground level non-enclosed stations, the travel patterns of other travellers are less controlled, making it more difficult to determine which travellers are coming from or going to the fare collection area.

(continued)

DECISIONS (In Order as They Occur on the Trip)		SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
V. (cont.)		4. Inference (e.g. "The fare collection area is usually straight ahead from the top/bottom of the stairs.")	4. Yes	4. Yes	4. Inconsistencies affect reliability of inference.	
B.	How will you actually locate the fare collection point?	B. 1. Characteristic visible architecture	B. 1. No	B. 1. Usually	B. 1. a. See V.A.1.a.&b, concerning poor lighting and inconsistent visual patterns. b. It may be possible to see the device, but not to see that it is out of order.	B. 1. See IV.A.1.a, concerning differences in light intensity.
		2. Characteristic physical appearance recognizable by touch.	2. Yes	2. Yes	2. a. Inconsistencies make this difficult in some places. b. It may be possible to locate the device, but not to determine that it is out of order.	2. No differences
		3. Sounds of fare collection devices	3. Yes	3. Yes	3. Machines may not be emitting sound when no other travellers are present.	3. See V.A.3, concerning difficulties in determining travel patterns of other travellers.
		4. Other travellers	4. Sometimes	4. Sometimes	4. Not always present	

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
V. (cont.) C. How will you know how to negotiate the fare collection device?	C. 1. It is well-labelled in large print.	C. 1. No	C. 1. Sometimes	C. 1. a. Print size, weight, and contrast may be poor. b. Lighting may be poor. c. Pressure of other travellers may allow insufficient time for reading.	C. 1. a. See I. A.1.a, concerning contrasts.
	2. The device is simple and self-evident (e.g. There is one slot and one bar.)	2. Yes	2. Yes	2. a. It may not be simple or self-evident. b. Multiple slots to accommodate different coins, tokens, or cards may be difficult to differentiate. c. Some devices require precise localization of slots and correct orientation of cards. This is more difficult for visually impaired travellers, especially those having peripheral neuropathy. d. Systems requiring purchase of tickets from automated vendors may require interpretation of much visually displayed information.	2. Devices which are in non-enclosed stations may become very cold. When the traveller's fingers are cold, and made colder by the device, tactile discrimination is impaired.

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
V. (cont.)	3. Anticipation from knowledge of other fare collection devices.	3. Yes	3. Yes	3. An excellent type of information, unless the design of the device is inconsistent (e.g.,a competent blind user of the MBTA would be utterly confused by the MARTA fare collection devices).	
	4. Trial and error	4. Yes	4. Yes	4. Visually impaired travellers do not like to look foolish poking and pushing about.	
D. How or where could you get change or assistance at this stage of your trip?	D. 1. Characteristic visual architecture of information/change booth.	D. 1. No	D. 1. Sometimes	D. 1. a. The architecture may not have conspicuous, recognizable, characteristics.	D. No differences.
	2. Characteristic architecture of information/change booth recognizable by touch.	2. Yes	2. Yes	2. The architecture may not have tactually distinctive characteristics.	
	3. Sight/sound of a queue of people waiting for information or change.	3. Yes	3. Yes	3. A good clue, but not always present, especially in unattended stations.	

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
VI. Locating waiting position.					
A. How do you know in what direction you should go to wait for the train?	A. 1. Characteristic visual architecture (e.g. "I can see the blackness of the pit"), or seeing a train waiting	A. 1. No	A. 1. Sometimes	A. 1. Poor lighting and visual contrast.	A. 1. See IV.A.1.a, concerning contrast.
	2. Signs and arrows	2. No	2. Occasionally	2. Signs and arrows may be inconsistent in placement (and presence), poorly lighted, and have poor print and contrast characteristics for low vision readers.	2. See I.A.1.a., concerning contrast.
	3. Other travellers	3. Sometimes	3. Sometimes	3. a. Other travellers are not always present. b. Other travellers may be going to wait for a different train or a train in the opposite direction.	3. No differences
	4. Sounds of the trains	4. Sometimes	4. Sometimes	4. a. Trains may be infrequent, and the visually handicapped traveller reluctant to wait for one train to pass just to locate the platform to wait for the next. b. The traveller may have no way to know whether the train he hears is the one he wants to take.	4. Wind, rain, or snow can dampen or distort the direction of sounds coming from trains.

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
VI. (cont.)					5. Visually impaired travellers commonly learn to negotiate open areas by following walls or other architectural features more closely than the usual pedestrian flow. If snow and ice are allowed to accumulate in the areas they customarily use, they become either less well-oriented, or experience a greater danger of falling.
B. How will you know you are on the right track?	B. 1. Signs 2. Characteristic visible name, code, etc. on train.	B. 1. No 2. No	B. 1. Occasionally 2. Occasionally	B. 1. See VI.A.2, concerning difficulties with signage. 2. The markings (or signs), when present, are usually not highly visible, and the low vision person may not even be able to locate the signs (much less read them) while a train is in motion. Graffiti may make signs illegible.	B. 1. See I.A.1.a, concerning contrast, 2. No differences

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
VI. (cont.)	3. Announcements of arrivals of trains.	3. Yes	3. Yes	3. a. When present in a station, this can be extremely helpful, although it may come too late for the visually handicapped traveller to change his position, if he needs to do so. b. Poor acoustics may make the announcements unintelligible.	3. Wind, rain, and snow can make announcements difficult to hear and to localize.
	4. Inference (e.g., "I entered this Red Line MBTA station by travelling west, toward Harvard Square, parallel to Massachusetts Avenue. I am still travelling in the same direction. I know that the track lies under Mass. Ave. at this point and goes east-west. I am on the north side of the parallel tracks. The	4. Sometimes	4. Sometimes	4. Usefulness of this source of information is limited to travellers having excellent spatial orientation, spatial memory, and some knowledge of the system.	4. No differences

(continued)

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VI. (cont.)	subway usually follows normal 'keep to the right' rules. Therefore the track in front of me should be for eastbound trains. That is the direction in which I wish to travel.")				
C. How will you locate a good place to wait for the train train?	C. 1. Visible edge of platform (or appearance of pit), combined with visual judgement of appropriate distance.	C. 1. No	C. 1. Sometimes	C. 1. a. Poor contrast and lighting make it difficult to see the edge or the pit itself. b. Brightly lighted or highly contrasting dividers between two tracks in the same pit can be so visually distracting that the low vision traveller thinks he should travel up to the lighted area. He is thus visually guided <u>into</u> the pit.	C. 1. See IV.A.1.a, concerning differences in intensity.
	2. Physical presence of platform edge ("drop") combined with with "time/ distance judgement"	2. Usually	2. Usually	2. a. See IV.A.2.a, concerning difficulties in detecting drops.	2. No differences

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
VI. (cont.)	of safe distance. (Visually handicapped traveller locates the drop with his cane and then walks away from it.)				
	3. Seating areas.	3. Occasionally	3. Sometimes	3. a. May be difficult to locate and recognize because of inconsistent placement, and inconsistent design and decoration. b. May be so far from the track that the traveller has difficulty recognizing and reaching the vehicle door before it closes.	3. No differences
	4. Other travellers	4. Sometimes	4. Sometimes	4. a. Other travellers may not always be present. b. Other travellers may be too too close to the pit. c. Other travellers may be travelling to different destinations, hence desiring to travel on different ends of the train than the visually handicapped traveller.	4. No differences

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
VI. (cont.)	5. Knowledge of specific landmark which indicates a good waiting position (e.g.,"When travelling from State St. to Government Center, I stand by the supporting column nearest the end of the station. That will place me near the front door of the first car--close to the stairs up to the middle level.")	5. Yes	5. Yes	5. Depends on familiarity with station and system.	5. No differences
	6. Signs (e.g. "First car stops here.")	6. No	6. Rarely	6. a. May be difficult to locate and read. b. Assure only that the traveller will be waiting near the train, but do not help him choose the "best" location for him.	6. No differences
	7. Inference (e.g.,"This seems to be about halfway between the ends of the track. I guess there is bound to be a car stopping here.")	7. Yes	7. Yes	7. a. May be difficult to visually or auditorally determine the halfway point. b. Not all visually handicapped travellers are able to use this kind of inference. c. Assures that the traveller is <u>probably</u> waiting where a car will stop, but does not help him choose a "best" location.	7. No differences

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
VI. (cont.) D. How will you know you're not getting too close to the drop?	D. 1. Location of other architectural features in relation to the drop (e.g., walls parallel to the track, seats, signs, supporting columns, etc., are usually a safe distance from the drop.)	D. 1. Sometimes	D. 1. Sometimes	D. 1. It may be difficult to locate such architectural features without exploration which brings the traveller too close to the drop.	D. 1. No differences
	2. Presence of contrast warning strip (color or texture) along platform form edge.	2. Sometimes	2. Sometimes	2. a. Not always present. b. Not always sufficiently recognizable from the surrounding floor, by even expert visually handicapped travellers.	2. May be tactually and visually obscured by snow, ice, or dirt.
VII. Anticipating train arrival					
A. How do you know the train is about to arrive in the station?	A. 1. Seeing the approaching train.	A. 1. No	A. 1. Sometimes	A. 1. Not always visible.	A. 1. No differences
	2. Hearing the approaching train.	2. Yes	2. Yes	2. The sound may be frightening, especially to the person who is not confident that he's waiting in a safe place.	2. No differences

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
	3. An announcement	3. Yes	3. Yes	3. When present, the acoustical characteristics of the announcement in relation to the ambient sound associated with the arrival of a train, may make the announcement unintelligible.	3. Wind, rain, or snow may dampen and distort verbal announcements, making them unintelligible.
	4. A sound signal	4. Yes	4. Yes	4. Usefulness of the signal depends on prior knowledge	4. Sound signals such as bells or tones are less liable to become unintelligible with distortions introduced by wind, rain, or snow.
VIII. Confirmation of correct train.					
A. How will you know whether the incoming train is the one you wish to take?	A. 1. Sign on the train	A. 1. No	A. 1. Occasionally	A. 1. See VI.A.2, concerning difficulties with signage.	A. 1. See I.A.1.a, concerning contrast.
	2. Announcement	2. Yes	2. Yes	2. See VII.A.3, concerning acoustical problems.	2. See VII.A.3, concerning influence of weather on acoustics.

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DECISIONS (in Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
IX. Boarding the train.					
A. How will you know the train has stopped and the doors are open, ready for you to board?	A. 1. Visible characteristics of an open door.	A. 1. No	A. 1. Usually	A. 1. Sameness of colors inside and outside a vehicle, especially when coupled with poor lighting, can make this a difficult task.	A. 1. Presence of glare or strong shadows on open platforms exaggerate the difficulty.
	2. Sound of opening door	2. Sometimes	2. Sometimes	2. It is often difficult to isolate the sound of an opening door from other ambient sounds.	2. Wind, rain or snow may mask or dampen the sound so it is not perceived.
	3. Sight of door opening	3. No	3. Sometimes	3. Contrast not always sufficient for good visibility.	3. No differences
	4. Movement of other persons waiting to board the train.	4. Yes	4. Yes	4. a. Not always present. b. In rush hour, travellers may "anticipate" the stopping train, inadvertently causing the visually handicapped traveller to move forward too soon.	
B. How will you locate an open door?	B. 1. Visible characteristics of an open door.	B. 1. No	B. 1. Yes	B. 1. See IX.A, concerning sameness of colors.	B. 1. See IX.A.1, concerning glare and shadows.

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
IX. (cont.)	2. Sound of door opening	2. Sometimes	2. Sometimes	2. a. See IX.A.2, concerning ambient noise. b. The most difficult sound to localize is one which only occurs once, briefly.	
	3. Movement of other travellers.	3. Sometimes	3. Sometimes	3. a. Either too much or too little movement can make this information source unreliable. b. A crowd can push a visually handicapped traveller, causing a mis-step onto a train or into the space between cars.	
	4. Physical characteristics of an open door (recognizable through exploration with cane, hand, or electronic travel aid).	4. Yes	4. Yes	4. a. Inconsistency makes the traveller unsure what to look for. b. An open gap between cars may be mistaken for an open door--leading the visually handicapped person to step into--NOTHING.	
C. How do you know where to place your foot as you step in? (Can you tell whether there is a gap or an elevation change?)	C. 1. Visible characteristics of the vehicle floor or threshold.	C. 1. No	C. 1. Sometimes	C. 1. Visual judgement of small, remote distances is very difficult. Poor lighting and contrast increase the difficulty.	C. 1. See IV.A.1.a, concerning differences in light intensity.
	2. Physical characteristics of the vehicle floor or threshold (recognizable with cane or foot).	2. Sometimes	2. Sometimes	2. a. When compelled to move quickly, it is difficult to notice small discontinuities in a surface or changes in elevation.	2. No differences.

(continued)

DECISIONS (in Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED b. Small gaps in surfaces or small changes in elevation are not readily detected with any electronic travel aid.	DIFFERENCES DEPENDING ON LEVEL OF STATION
IX. (cont.)	3. Assumption (trial and error, inference) (e.g., "I know there may be a gap or an elevation change. Therefore, I'll step far into the vehicle and step high, waiting to shift my weight to the foot which is in the vehicle until that foot is securely and fully resting on the vehicle floor.")	3. Yes	3. Yes	3. Probably the most common source of information used in this situation.	3. No differences.
X. Riding on the train. A. As you enter the train, how will you find something to hold onto, to maintain your balance?	A. 1. Visible characteristics of a handrail, strap, etc.	A. 1. No	A. 1. Sometimes	A. 1. Poor lighting, poor contrast, and inconsistent placement make visual identification of rails and bars difficult.	1. See IV.A. 1.a, concerning differences in intensity.
	2. Inference (e.g."There is usually a vertical or horizontal bar attached to the door frames", etc.)	2. Yes	2. Yes	2. Inconsistent placement makes inference very approximate unless the visually handicapped traveller is familiar with the specific vehicle types he rides. Slight variations in vehicles on the same line can be very confusing.	2. No differences

(continued)

X. (cont.)

DECISIONS (in Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
	3. Physical characteristics of the rails, etc.	3. Yes	3. Yes	3. A railing is usually recognizable by touch, but a visually handicapped traveller may dislike groping for a railing with his hand or cane, risking physical contact with other passengers, or feeling conspicuous.	3. No differences
B. How will you find a seat?	B. 1. Visible characteristics of a seat	B. 1. No	B. 1. Sometimes	B. 1. Poor contrast between seats and surrounding areas	1. See IV.A.1.a, concerning differences in intensity.
	2. Haptic exploration (active exploration with cane, hand, or electronic travel aid).	2. Yes	2. Yes	2. A majority of visually handicapped travellers prefers not to use this technique because it is considered socially inappropriate, it is time-consuming and it is often awkward, and it may lead to embarrassing situations.	2. No differences
C. How will you know the seat is empty?	C. 1. Visible characteristics.	C. 1. No	C. 1. Sometimes	C. 1. Many low vision persons can see that a seat is empty when they are close enough to touch that seat, but they cannot scan a row of seats, noting where there is an empty seat, and then head for that seat. Each seat in the row must be approached and examined.	C. 1. No differences
	2. Haptic exploration	2. Yes	2. Yes	2. See X.B.2.	2. No differences
	3. Seeing a passenger leave a seat. (One cannot usually locate a seat auditorily by this means, because of high ambient noise levels.)	3. No	3. Sometimes	3. Visually handicapped person must wait one or more stops before having the information he needs to locate a seat.	3. No differences

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DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
XI. Anticipating the desired stop (station).					
A. How will you know the next stop is yours, so you can prepare to exit?	A.	A.	A.	A.	A.
	1. Announcement	1. Yes	1. Yes	1. Poor audio quality	1. No differences.
	2. Counting stops	2. Yes	2. Yes	2. a. Depends on some knowledge of the line on which one is travelling. (Normally sighted persons can check with route maps posted in vehicles. The low vision traveller cannot usually locate or readily use these maps while a vehicle is in motion. b. Depends on consistent attention to train motions and sounds.	2. No differences.
	3. Recognition of station characteristics (visual and auditory)	3. Yes	3. Yes	3. Some lines are characterized by stations which are so similar in visual and auditory characteristics that this information source is not useful. The information is not available soon enough for travellers to prepare to exit efficiently and calmly.	3. Poorly lighted underground stations, or the presence of tinted glass in the vehicles make it difficult to see out of the vehicles.
	4. Signs	4. No	4. Occasionally	4. Inconsistency in location of signs makes them hard to find. Poor lighting, contrast, style, and size make them illegible to many low vision persons. The informa- is not perceived soon enough for travellers to prepare to exit efficiently and calmly.	4. See I.A.1.a., concerning contrast.

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DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
XI. (cont.)					
B. How will you know the train is in the station?	B.1. Seeing/hearing/feeling the stopping of the train, in combination with:	B.	B.	B.	B. No differences
	1a. Seeing the doors open	1.a. No	1a. Usually	1a. Poor lighting and contrast, plus crowded conditions, can make it difficult to see the doors open.	
	b. Hearing the doors open	b. Sometimes	b. Sometimes	b. 1) Ambient noise intensity may be above the intensity of the sound/s emitted as the doors open. 2) The opening of some doors (especially on newer vehicles) is nearly silent.	
	2. Crowd surge toward the open door. (This can be seen, heard, or felt.)	2. Yes	2. Yes	2. This is an excellent clue for all visually handicapped travellers <u>when</u> there is a crowd exiting at the same stop.	
XII. Exiting the train.					
A. How will you know in what direction to search for the train door?	A. 1. Visible characteristics of the open door.	A. 1. No	A. 1. Sometimes	A. 1. See XI. B. 1, concerning lighting and contrast.	A. No differences
	2. Hearing the doors open.	2. Sometimes	2. Sometimes	2. See X.1.B.1.b, concerning the effects of ambient noise and of silent doors.	
	3. Crowd surge.	3. Yes	3. Yes	3. See XI.B. 2, concerning crowd surge.	

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DECISIONS (in Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
XII. (cont.)	4. Spatial memory (I'll return to the door where I entered.	4. Usually	4. Usually	4. The spatial memory of some visually handicapped persons is poor, even for relatively simple routes, covering short distances. They are thus dependent on 1, 2, or 3, above.	
B. How will you find something to hold onto, as you move toward the door?	See X.A., 1. 2, and 3, concerning seeing handrails, anticipating locations of handrails, and groping to actually locate handrails.				B. No differences
C. How will you actually locate the open door?	C. 1. Visible characteristics of the open door.	C. 1. No	C. 1. Sometimes	C. 1. See XI.B.1.a, concerning poor lighting and contrast,	C. No differences
	2. Hearing the door open	2. Sometimes	2. Sometimes	2. a. See XI.B.1.b,1) &2) concerning ambient noise and silent doors. b. Requires ability to locate the source of a sound which is emitted once, briefly, amid considerable ambient noise. This is a very difficult auditory task. c. Requires good memory for a position determined auditorily, and requires that the traveller be able to walk in a straight line toward a known position.	
	3. Crowd surge	3. Yes	3. Yes	3. a. See XI. B.2, concerning crowd surge, b. Although it is a helpful source of directional information, the visually handicapped person may be fearful of moving as part of the crowd because he may stumble and	(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
XII. (cont.)				fall as he steps onto the platform, having insufficient time to determine where to place his foot.	
D. How will you know where to place your foot as you step out?	See IX.C.1,2, & 3 concerning visible characteristics of the floor, physical characteristics of the floor, and assumptions concerning distance of the floor.				D. No differences
XIII. Locating the station exit.					
A. How will you know which exit to take out of the station? (Assuming a station having multiple exits)	A. 1. Signs	A. 1. No	A. 1. Sometimes	A. 1. See VI,A,2, concerning poor signs for low vision readers. Also, emergency exits may be labelled similarly to, or as conspicuously as regular exits, leading to confusion.	A. 1. See I.A.1.a., concerning contrast.
	2. Prior familiarity	2. Yes	2. Yes	2. Not useful in unfamiliar station.	2. No differences
	3. Verbal information (telephone, transit information booth).	3. Sometimes	3. Sometimes	3. The information person either does not know or does not inform the caller that there are multiple exits, and if he/she does, he/she may not know which exit is nearest to the desired destination.	3. No differences
	4. Assumption that general indicators of an exit (e.g. other transit users, more light, more pedestrian noise) will lead to an appropriate exit.	4. Yes	4. Yes	4. The most used or most conspicuous exit may not be the most direct route for the visually handicapped traveller to take to his destination.	4. No differences

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
XIII. (cont.)	A.	A.	A.	A.	A.
	5. Station maps	5. No. (The investigators are not aware of any tactile maps of stations in this country. Some do exist in England.)	5. Rarely	5. Existing maps (in systems which provide them) may be hard to obtain (portable maps) or hard to locate (fixed maps). Their graphic and print characteristics may limit their readability for low vision travellers.	5. See I.A.1.a, concerning contrast.
B. How do you know the general direction in which to go, to reach the exit you want to use?	B.				B.1. No differences
	1. See XII.A.1, & 4, concerning visible characteristics, hearing doors, crowd surge, and spatial memory, respectively.				
	2. Verbal information	2. Sometimes	2. Sometimes	2. a. See XIII.A.3. b. Information persons are commonly unable to give verbal directions in terms meaningful to the visually handicapped traveller.	2. No differences 3. If snow and ice are incompletely removed from an exposed platform, the visually impaired traveller assumes that the clearest area leads to an exit.
C. How will you actually find the exit turnstile (or other device)?	C.				
	See V.B.1,2,3,&4 concerning characteristic visible architecture, characteristic tactile properties, sounds emitted, and other travellers, respectively.				
D. How will you know how to negotiate the turnstile?	D.				
	See V.C.1,2,3,&4 concerning labeling, simplicity of the device, anticipation of characteristics, and trial and error, respectively.				

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
XIII. (cont.)	E.				
E. How will you know the general direction in which to travel to reach the stairs (escalator or elevator)?	See IV.A.1,2,3,4,&5---------- concerning characteristic visible architecture, change in elevation, other pedestrians, sound and/or vibration of escalator or elevator, and clues characteristic of specific environments.				
	F.				
F. How will you actually locate the first riser? (escalator or elevator)?	See IV.B.1&2---------- concerning characteristic visible architecture and obstacle or drop at floor level.				
	G.				
G. How will you know whether the stairs (escalator, elevator) go up or down?	See IV.C.1,2,3,&4---------- concerning characteristic visible architecture, obstacle or drop, inference, and other travellers, respectively.				
	H.				
H. How will you find the handrail?	See IV.D.1&2---------- concerning characteristic visible architecture, and physical present of the handrail.				
I. How will you know in what direction to travel from the stairs (escalator or elevator)?	I. 1. Characteristics of visible architecture	I. 1. No	I. 1. Sometimes	I. 1. Poor lighting and/or contrast make visual location of exits difficult.	I. 1. See IV.A.1.a., concerning differences in intensity.
	2. Other exiting pedestrians	2. Yes	2. Yes	2. a. There may be no other pedestrians exiting at the same time. b. The visually handicapped traveller may not be able to follow them as fast as they are travelling (but may, nonetheless, get a general idea of direction).	2. a. No differences b. On a slippery platform the visually impaired traveller will have increased difficulty in "keeping up with the crowds".

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DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
XIII. (cont.)	3. Change in air currents.	3. Yes	3. Yes	3. Depending on the exit architecture, and whether doors are open or closed, the change in air currents may be minimal.	3. No differences
K. How will you actually locate the exit?	K. 1. See XII.I.1,2,&3--- concerning characteristic visible architecture, other pedestrians, and change in air currents, respectively.				
XIV. Regaining city orientation.					
A. How do you know where you are, now that you've reached the outside of the station?	A. 1. Familiar visual landmarks (a known intersection, building, etc.)	A. 1. No	A. 1. Sometimes	A. 1. a. The area may have no good, visually distinctive landmarks. b. The traveller may be unfamiliar with landmarks in the area.	A. 1. No differences
	2. Signs	2. No	2. Sometimes	2. See VI.A.2., concerning poor signage for low vision readers.	2. See I.A.1.a. concerning contrasts.
	3. Transit telephone information	3. Sometimes	3. Sometimes	3. Telephone information person may be unfamiliar with exact locations of all exits from all stations, or may be unable to describe the positions of exits in terms meaningful to the visually handicapped traveller.	3. No differences
GENERAL TOPICS					
A. Locating lavatories.					A. See 1.A.1.a. above, concerning contrasts.
1. Where (how) would you find a men's (ladies') room en route?	A. 1. Signs (or visual symbols)	A. 1. No	A. 1. Sometimes	A. 1. See VI.A.2., concerning poor signage for low vision readers.	

(continued)

	DECISION (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
		2. Station maps See XIII.A.5. concerning station maps.				
B.	Locating telephones.					
	1. Where (how) would you find a telephone if you needed to make a call en route?	See General Topics A.1&2 concerning signs and maps.				
C.	Avoiding obstacles and hazards.	C. 1. Visual characteristics.	C. 1. No	C. 1. Sometimes	C. 1. Poor lighting and contrast make some obstacles difficult to detect.	C. 1. See IV.A.1.a. concerning differences in light intensity.
		2. Auditory obstacle detection.	2. Sometimes	2. Not commonly used by low vision persons.	2. High ambient noise levels in transit environments make auditory obstacle detection difficult, even for persons who commonly use this technique.	2. Snow, wind or rain make this technique nearly impossible to use.
		3. Contact or detection with travel aid such as long cane, electronic travel aid, or dog guide.	3. Yes	3. Yes	3. a. Although most obstacles are potentialiy detectable by most visually handicapped travellers using most travel aids, poor technique, confusion, or a malfunctioning aid can cause visually handicapped persons to bodily contact obstacles which they otherwise could have avoided. b. Some obstacles are particularly difficult, if not impossible, to detect with some travel aids (for example, the long cane, properly used, will not detect a phone booth hung and projecting out from the wall.)	3. The "most travelled path" in a station inadequately cleared of ice and snow, is generally obstacle-free.

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DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
D. Establishing/maintaining direction.	D,	D,	D,	D,	D.
1. Assuming you know where you want to go to negotiate open areas in a station, how do you establish your travel direction and maintain a straight line of travel?	1. Fixating on a visible landmark	1. No	1. Usually	1. Lighting and contrast may be so poor that no visible landmarks (not even distinctively light or dark areas) can be detected.	1. See IV.A.1.A., concerning differences in light intensity.
	2. Fixating on a sound source.	2. Sometimes	2. Sometimes	2. a. High ambient noise levels make it difficult to use this common source of information. b. There may be no sound source in the direction the traveller wishes to go. (It is much more difficult to maintain a straight line of travel by walking away from or walking past a sound source.)	2. Wind, rain and snow can make relevant sounds more difficult to hear and harder to localize.
	3. Paralleling a wall. (at some distance greater than cane reach). Some electronic travel aids are excellent for this purpose.	3. Rarely	3. Usually	3. a. Poor lighting and contrast make this difficult for the low vision traveller. b. High ambient noise makes it nearly impossible for the totally blind traveller to travel parallel to a wall by using reflected sound, as can be done by some travellers in a quiet environment.	3. No differences

(continued)

	DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
					d. There is not always a parallel wall going in the same direction the traveller wishes to go.	
D_4		4. Following other travellers.	4. Yes	4. Yes	4. a. There are not always other travellers going in the desired direction. b. It may be impossible to know whether other travellers are going in the same direction the visually handicapped travellers wishes to go. c. The visually handicapped traveller may not be able to keep up with fully sighted pedestrians.	4. No differences
E.	Obtaining assistance.	E.	E.1.	E.1.	E.1.	E. No differences
	1. How do you find someone to answer a question?	1. a. Look for transit personnel near fare collection area or on platform. b. Prior knowledge of the location of transit personnel.	a. No b. Occasionally	a. Occasionally b. Occasionally	a. Poor lighting and uniforms that blend into the environment (e.g., tan or gray) make it difficult for the low vision person to spot transit personnel. b. The traveller who knows where he can find transit personnel is usually the one who doesn't need assistance.	
	2. How do you find someone to guide you, if necessary?	2. See General Topics E.1. concerning finding someone to answer a question.				

(continued)

DECISIONS (In Order as They Occur on the Trip)	SOURCES OF AVAILABLE INFORMATION	USEFUL TO TOTALLY BLIND TRAVELLERS?	USEFUL TO LOW VISION TRAVELLERS?	PROBLEMS IN EXISTING INFORMATION SOURCES WHICH LIMIT THEIR USEFULNESS BY THE VISUALLY IMPAIRED	DIFFERENCES DEPENDING ON LEVEL OF STATION
3. How do (can) you find a map that you can read?	3. a. Visual characteristics.	a. No	a. Occasionally	a. Map locations (and maps themselves) are often poorly lighted and low in contrast.	
	b. Anticipation of common locations.	b. No	b. Occasionally	b. Where fixed maps are present, in predictable locations, the low vision travelier is likely to be abie to find them.	
F. Emergency procedures.	F.	F.1.	F.1.	F.1.	F. All differences may be exaggerated by glare, wind, rain, snow, or extreme heat or cold.
1. How would you know there was an emergency?	1. a. Announcement	a. Yes	a. Yes	a. Emergency situations do not always lend themselves to clear auditory announcements	
	b. Emergency warning signal.	b. Yes	b. Yes	b. Requires that the travelier be familiar with the meaning of the warning signal.	
	c. Unusual sight, sound, odor or motion	c. Yes	c. Yes	c. Any of these may indicate the presence of an emergency situation but not enable the visually handicapped perceiver to determine the nature or location of the difficulty.	
	d. Crowd chaos	d. Yes	d. Yes	d. This clear indication of trouble is likely to bring fear and/or panic to the visually handicapped traveller who is unable to determine the source or nature of the difficulty.	
2. How would you know where to go, or what to do?	2. a. Announcement	See General Topics F.1.a, concerning announcements.			
	b. Follow the crowd	b. Yes	b. Yes	b. 1) Requires the presence of other passengers 2) Requires that the visually handicapped traveller be able to readily track (visually or auditorally) other pedestrians, and follow them with alacrity, often over poorly lighted, irregular terrain.	

APPENDIX E

SCRIPT USED BY ORIENTATION AND MOBILITY SPECIALISTS

WHEN CONDUCTING ON-SITE STUDIES

"Today we're going to take a trip together on the subway. I'm going to be asking you questions regularly about how you get the information you need as you go along. I'll be tape-recording my questions and your responses. I'd like you to actually travel each section as independently as you normally would. At points where you would normally solicit information or assistance, I'll be glad to help you. I don't want you to be more, or less, independent than if you had to travel the route by yourself. Remember, this is in no way a test of your travel skills. We're interested in what needed information the subway system does or does not give you as you travel."

"We want to get from_____to_____.

Topic 1. Obtaining route information.

A. HOW WOULD YOU FIND OUT WHAT LINE TO TRAVEL ON, AND AT WHICH STATIONS TO GET ON AND OFF?

(Drive to parking point near the first station.)

Topic 2. Locating the station.

A. HOW WILL YOU FIND THE STATION?

(Have S find station, soliciting aid from you, if needed. If S uses, or appears to use sources of information other than those he's mentioned, the E should ntion this on tape, or ask the S about it before the next topic.)

Topic 3. Locating the entrance.

A. HOW WILL YOU FIND THE ENTRANCE TO THE STATION?

(Have S find entrance.)

Topic 4. Locating and negotiating stairs (escalator or elevator).

A. HOW DO YOU KNOW IN WHAT DIRECTION THE STAIRS ARE FROM THE ENTRANCE?

B. IN WHAT DIRECTION ARE THE STAIRS FROM THE ENTRANCE?

(Have S verbalize or point. E should clarify explanation and its accuracy on tape.)

C. HOW WILL YOU LOCATE THE FIRST RISER?

D. HOW WILL YOU KNOW WHETHER THE STAIRS GO UP, OR DOWN?

E. HOW WILL YOU FIND THE HANDRAIL, IF YOU USE IT?

Topic 5. Locating and negotiating fare collection area.

A. HOW DO YOU KNOW IN WHAT DIRECTION THE FARE COLLECTION POINT IS FROM THE ENTRANCE?

B. IN WHAT DIRECTION WILL YOU GO TO REACH THE FARE COLLECTION POINT?

(Have S verbalize or point. E should clarify on tape.)

C. HOW WILL YOU ACTUALLY LOCATE THE FARE COLLECTION POINT?

D. HOW WILL YOU KNOW HOW TO NEGOTIATE THE FARE COLLECTION DEVICE?

E. HOW OR WHERE COULD YOU GET CHANGE OR ASSISTANCE AT THIS STAGE OF YOUR TRIP?

(Have S go to and through the fare collection device, etc.)

Topic 6. Locating waiting position.

A. HOW DO YOU KNOW IN WHAT DIRECTION YOU SHOULD GO TO WAIT FOR THE TRAIN?

B. IN WHAT DIRECTION DO YOU GO TO WAIT FOR THE TRAIN?

(Have S verbalize or point. E should clarify explanation and its accuracy on tape.)

C. HOW WILL YOU KNOW YOU ARE ON THE RIGHT TRACK?

D. HOW WILL YOU LOCATE A GOOD PLACE TO WAIT FOR THE TRAIN (CONSIDER BOTH DISTANCE FROM TRAIN AND POSITION ALONG LENGTH OF PLATFORM)?

E. HOW WILL YOU BE SURE YOU'RE NOT GETTING TOO CLOSE TO THE DROP?

(Have S go to where he'd wait for train, and signal to E when he's in position.)

Topic 7. Anticipating train arrival.

A. HOW DO YOU KNOW THE TRAIN IS ABOUT TO ARRIVE IN THE STATION?

Topic 8. Confirmation of correct train.

A. HOW WILL YOU KNOW WHETHER THE INCOMING TRAIN IS THE ONE YOU WISH TO TAKE?

Topic 9. Boarding the train.

A. HOW WILL YOU KNOW THE TRAIN HAS STOPPED AND THE DOORS ARE OPEN, READY FOR YOU TO BOARD?

B. HOW WILL YOU LOCATE AN OPEN DOOR?

C. HOW DO YOU KNOW WHERE TO PLACE YOUR FOOT AS YOU STEP IN? (CAN YOU TELL WHETHER THERE IS A GAP OR AN ELEVATION CHANGE?)

Topic 10. Riding on the train.

A. AS YOU ENTER THE TRAIN, HOW WILL YOU FIND SOMETHING TO HOLD ONTO, TO MAINTAIN YOUR BALANCE?

B. HOW WILL YOU FIND A SEAT?

C. HOW WILL YOU KNOW THE SEAT IS EMPTY?

Topic 11. Anticipating the desired stop (station).

A. HOW WILL YOU KNOW THE NEXT STOP IS YOURS, SO YOU CAN PREPARE TO EXIT?

B. HOW WILL YOU KNOW THE TRAIN IS IN THE STATION?

Topic 12. Exiting the train.

A. HOW WILL YOU KNOW IN WHAT DIRECTION TO SEARCH FOR THE TRAIN DOOR?

B. HOW WILL YOU FIND SOMETHING TO HOLD ONTO, AS YOU MOVE TOWARD THE DOOR?

C. HOW WILL YOU ACTUALLY LOCATE THE OPEN DOOR?

D. HOW WILL YOU KNOW WHERE TO PLACE YOUR FOOT AS YOU STEP OUT?

(Have S board the next train, locate a seat, ride to the desired exit station, and exit the train.)

Topic 13. Locating the station exit.

A. HOW WILL YOU KNOW WHICH EXIT TO TAKE OUT OF THE STATION?

B. HOW DO YOU KNOW THE GENERAL DIRECTION IN WHICH TO GO, TO REACH THE EXIT YOU WANT TO USE?

C. IN WHAT DIRECTION WILL YOU GO TO REACH THE EXIT? (point or verbalize)

D. HOW WILL YOU ACTUALLY FIND THE EXIT TURNSTILE (OR OTHER DEVICE)?

E. HOW WILL YOU KNOW HOW TO NEGOTIATE THE TURNSTILE?

F. HOW WILL YOU KNOW THE GENERAL DIRECTION IN WHICH TO TRAVEL TO REACH THE STAIRS, ESCALATOR OR ELEVATOR?

G. HOW WILL YOU ACTUALLY LOCATE THE FIRST RISER? (ESCALATOR OR ELEVATOR)

H. HOW WILL YOU KNOW WHETHER THE STAIRS (ESCALATOR, ELEVATOR) GO UP OR DOWN?

I. HOW WILL YOU FIND THE HANDRAIL?

J. HOW WILL YOU KNOW IN WHAT DIRECTION TO TRAVEL FROM THE STAIRS (ESCALATOR OR ELEVATOR)?

K. HOW WILL YOU ACTUALLY LOCATE THE EXIT?

(Have S exit the station.)

Topic 14. Regaining city orientation.

A. HOW DO YOU KNOW WHERE YOU ARE, NOW THAT YOU'VE REACHED THE OUTSIDE OF THE STATION?

General Topics (Special Concerns)

Topic A. Locating lavatories.

1. WHERE (HOW) WOULD YOU FIND A MEN'S (LADIES') ROOM EN ROUTE?

Topic B. Locating telephones.

1. WHERE (HOW) WOULD YOU FIND A TELEPHONE IF YOU NEEDED TO MAKE A CALL EN ROUTE?

Topic C. Avoiding obstacles and hazards.

1. HOW DO YOU AVOID OBSTACLES AS YOU TRAVEL IN STATIONS OR ON TRAINS?

2. ARE THERE ANY PARTICULAR KINDS OF OBSTACLES WHICH YOU HAVE DIFFICULTY DETECTING AND AVOIDING?

3. HOW DO YOU AVOID HAZARDS SUCH AS SUDDEN DROPS?

4. ARE THERE ANY PARTICULAR HAZARDS WHICH YOU HAVE DIFFICULTY DETECTING AND AVOIDING?

Topic D. Establishing/maintaining direction.

1. ASSUMING YOU KNOW WHERE YOU WANT TO GO TO NEGOTIATE OPEN AREAS IN A STATION, HOW DO YOU ESTABLISH YOUR TRAVEL DIRECTION AND MAINTAIN A STRAIGHT LINE OF TRAVEL?

Topic E. Obtaining assistance.

1. HOW DO YOU FIND SOMEONE TO ANSWER A QUESTION?

2. HOW DO YOU FIND SOMEONE TO GUIDE YOU, IF NECESSARY?

3. HOW DO (CAN) YOU FIND A MAP THAT YOU CAN READ?

4. WHAT ARE YOUR PROBLEMS IN USING AVAILABLE MAPS?

Topic F. Emergency procedures.

1. HOW WOULD YOU KNOW THERE WAS AN EMERGENCY?

2. HOW WOULD YOU KNOW WHERE TO GO, OR WHAT TO DO?

Topic G. Special adaptations for visually impaired users.

1. ARE YOU AWARE OF _____?

2. HAVE YOU EVER USED _____?

3. DO YOU USE IT OFTEN?

4. IF YOU DID NOT HAVE THIS ADAPTATION, WOULD YOUR TRAVEL BE MORE DIFFICULT OR LESS SAFE?

Special Concerns of Individual Travellers

1. WHAT DO YOU CONSIDER TO BE YOUR THREE MAJOR DIFFICULTIES IN USING THE SUBWAY?

2. IF THESE DIFFICULTIES DID NOT EXIST OR WERE NOT AS SEVERE, WOULD YOU BE LIKELY TO USE THE SUBWAY MORE?

3. ARE THERE SOME TIMES OR SITUATIONS IN WHICH YOU SIMPLY WOULD NOT USE THE SUBWAY, EVEN THOUGH IT WAS, FOR NON-VISUALLY IMPAIRED TRAVELLERS, THE FASTEST WAY TO REACH YOUR DESTINATION?

4. ARE THERE ANY PARTICULAR CHANGES YOU WOULD LIKE TO SEE MADE, WHICH YOU BELIEVE WOULD MAKE YOUR USE OF THE SUBWAY EASIER OR SAFER?

APPENDIX F

TRANSCRIPTIONS OF THREE ON-SITE INTERVIEWS WITH VISUALLY IMPAIRED TRAVELLERS

Subject's Name: Regina C. (Totally Blind)

Interviewer: Vicky Berg

Topic 1.

A. HOW WOULD YOU FIND OUT WHAT LINE TO TRAVEL ON, AND AT WHICH STATIONS TO GET ON AND OFF?

Using the tactile subway map I would locate first the station where I'm going from then the one that I'm going to and I would check the number of stations between the two of them and if there is any transfer that I would have to do.

IF YOU DID NOT HAVE THE MAP, IS THERE SOMETHING ELSE YOU WOULD DO?

Once being at the station, I would go to the information booth at the station. Otherwise I could call previously the MBTA Information Office and ask specific questions.

ONCE YOU HAVE FOUND THE LINE, HOW DO YOU KNOW WHICH STATIONS TO GET ON AND OFF AT?

I would use telephone or information person at the station and if it is an unknown route I would ask at each station which one it is.

HOW WOULD YOU FIND THE STATION ITSELF?

I'm going to put as an example a doctor's appointment that I will have to go to. What I will do to locate the station is call the doctor's office because I don't think I could get enough information from the MBTA people and ask them how far am I from the station and some specific questions like "How many blocks to the right or left am I from the station?" and I would ask if they station is right in the middle of the block or in a corner. That would be a great help.

Topic 3.

A. HOW WILL YOU LOCATE THE ENTRANCE TO THE STATION?

Mainly by sound, many times by smell.

WHAT SOUNDS?

There's a sound of depth and sometimes there is like a whole world going on inside...the warmth as well.

CAN YOU SEE ANY OF THE LIGHTS IN THE STATION?

No...Also at the entrance I would expect stairs...

TO HEAR THE STAIRS?

Yes. People coming up, mainly.

HOW DO YOU KNOW WHAT DIRECTION THE STAIRS ARE FROM THE ENTRANCE?

The people give me the feeling. That would be my main thing. Otherwise, I would trail the wall on the right.

DO YOU KNOW, IN THIS STATION, IN WHICH DIRECTION TO GO TO GET TO THE STAIRS?

No.

Topic 4.

C. HOW WILL YOU LOCATE THE FIRST RISER?

With a cane.

D. HOW WILL YOU KNOW WHETHER THE STAIRS GO UP, OR DOWN?

By feeling them and by listening to people.

E. HOW WILL YOU FIND THE HANDRAIL, IF YOU USE IT?

I would go up to the first step and trail before going down to my right or left until I find it.

Topic 5.

A. HOW DO YOU KNOW IN WHAT DIRECTION THE FARE COLLECTION POINT IS FROM THE ENTRANCE?

I would wait for sounds of the turnstiles. Also I would follow the people coming into the subway.

B. IN WHAT DIRECTION WILL YOU GO TO REACH THE FARE COLLECTION POINT?

It's about at 11:30.

C. HOW WILL YOU ACTUALLY LOCATE THE FARE COLLECTION POINT?

By walking to it and feeling for it, but one of my main problems is... I know the information booths are to the right or the left but I don't know if they follow a pattern or if I should just look for them.

HOW WOULD YOU FIND THE PLACE TO GET CHANGE OR ASSISTANCE?

By following the turnstiles and then I know it is to the side of it. Not which side, though, not even at the gate where handicapped people go through.

D. HOW WILL YOU KNOW HOW TO NEGOTIATE THE FARE COLLECTION DEVICE?

This time I heard some conversation and so I knew where the booth was. When I got to the turnstile I just went toward the conversation. I felt for the place where you pass the bill under and then talked to the person in the booth.

HOW DID YOU KNOW THEN IN WHICH DIRECTION TO GO TO GET TO THE TURNSTILE?

I wanted to get to them by listening to the sound but I hit the gate instead of the turnstile and this time I went through the gate.

IS IT USUALLY EASIER FOR YOU TO FIND THE GATE OR THE TURNSTILE?

Usually the turnstile.

WHY?

I don't know whether they follow a pattern or not and usually it is confusing to reach the gate if there are people around.

IS IT EASIER TO MISS THE GATE THAN THE TURNSTILE?

Yes, because there's not as much sound and you can get in the middle of the row and it's just easier to go through.

Topic 6.

A. HOW DO YOU KNOW IN WHAT DIRECTION YOU SHOULD GO TO WAIT FOR THE TRAIN?

I would listen again for the train and for the people. It gets to be confusing if there are many ins and outs to get to the tracks. Sometimes the information booth is very helpful in that. Sometimes it is hard to get instructions so you ask any stranger.

WOULD YOU ORDINARILY TRY TO GET INFORMATION FROM THE MAN IN THE BOOTH?

No, because there is also a sound problem. Sometimes you don't catch all of the information because of the window.

B. IN WHAT DIRECTION DO YOU GO TO WAIT FOR THE TRAIN?

I have to analyze it first. I think it is to the right because I hear people, and a lot of banging there. I could ask someone over by the turnstiles.

HOW WOULD YOU KNOW WHICH STAIRS TO GO DOWN?

By following the railing. The stairs have a rubber surface and the platforms are cement.

C. HOW WILL YOU KNOW YOU ARE ON THE RIGHT TRACK?

By asking any stranger.

D. HOW WILL YOU LOCATE A GOOD PLACE TO WAIT FOR THE TRAIN (CONSIDER BOTH DISTANCE FROM TRAIN AND POSITION ALONG LENGTH OF PLATFORM)?

I would wait for a few trains to go by and see where they stop and keep moving closer to that area, and once I am sure I would face the tracks, listen for the train and once it stops, trail the train to the door. At that point it would be mainly following people, which way do they go.

E. HOW WILL YOU BE SURE YOU ARE NOT GETTING TOO CLOSE TO THE DROP?

I would have no idea except my cane. I hope my cane would drop first and then myself.

THERE IS AN EIGHTEEN-INCH WIDE RUBBER OR PLASTIC STRIP BY THE TRACK.

This is the first time I have found this strip in a station.

WHAT WOULD YOU EXPECT THE RELATIONSHIP OF THIS STRIP TO BE TO THE TRACK?

Parallel.

HOW FAR WOULD YOU EXPECT IT TO BE FROM THE TRACK?

At the most, two feet.

HOW WILL YOU KNOW WHICH WAY TO WALK TO GET TO WHERE THE TRAINS ARE STOPPING?

Because of the direction in which the trains are running--auditory and tactile--I would use the plastic thing and measure, mentally, the distance between where the last one stopped and I would walk such a distance.

Topic 7.

A. HOW DO YOU KNOW THE TRAIN IS ABOUT TO ARRIVE IN THE STATION?

By sound.

Topic 8.

A.. HOW WILL YOU KNOW WHETHER THE INCOMING TRAIN IS THE ONE YOU WISH TO TAKE?

I would ask the person next to me or someone around.

WOULD YOU WAIT UNTIL THE TRAIN IS PULLING IN TO GET THAT INFORMATION?

Yes, because I know some of the stations and the direction that the trains come from. Also, in busy stations I know that trains are going to branch out from there. If it was a small one or an outside station I don't think I would ask anyone.

Topic 9.

A. HOW WILL YOU KNOW THE TRAIN HAS STOPPED AND THE DOORS ARE OPEN, READY FOR YOU TO BOARD?

By sound. There is a very distinct sound of doors opening and people walking in and out.

B. HOW WILL YOU LOCATE AN OPEN DOOR?

By walking straight to the train, feeling the side of the train and trailing towards where people are until I find the empty space and that's the door.

C. HOW DO YOU KNOW WHERE TO PLACE YOUR FOOT AS YOU STEP IN? (CAN YOU TELL WHETHER THERE IS A GAP OR AN ELEVATION CHANGE?)

The cane in front of me. Also, if there's a person straight ahead I can follow.

Topic 10.

A. AS YOU ENTER THE TRAIN, HOW WILL YOU FIND SOMETHING TO HOLD ONTO, TO MAINTAIN YOUR BALANCE?

Mainly by moving my hand slowly. Generally, all trains are structured so they have poles close to the doors. I guess that's all I ever do. I put my hand at waist height, palms in, and sweep sideways.

B. HOW WILL YOU FIND A SEAT?

I usually let people tell me whether there is a seat or not. If I'm too tired I use the cane to find the seat and whether there is anyone sitting there or not. Most of the time there is no need for that because by that time everyone jumped at you and they would let you know if there's one free or if everything is occupied.

Topic 11.

A. HOW WILL YOU KNOW THE NEXT STOP IS YOURS, SO YOU CAN PREPARE TO EXIT?

Counting mainly. In some lines drivers are good and let you know what stop it is verbally. Not every time though. And when I have to count that can lead to mistakes because sometimes trains stop in between stops. One has to be very careful to tell if the door is open or not to be able to tell if it's a station or not.

WHEN YOU ARE INSIDE THE TRAIN AND YOU KNOW THAT YOUR STOP IS THE NEXT ONE, HOW DO YOU PREPARE TO GET OFF?

I usually let the train go, start again towards my destination... After a minute or two, I would stand up, locate the door, and wait until it stops.

HOW WILL YOU KNOW WHEN THE TRAIN IS IN THE STATION WHERE YOU WANT TO EXIT?

By the door opening. Sometimes the driver lets me know. I usually make sure by confirming with any stranger.

Topic 12.

A. HOW WILL YOU KNOW IN WHAT DIRECTION TO SEARCH FOR THE TRAIN DOOR?

As soon as I get in the subway I make a mental picture of the distance I walk from the door to the seats. The most convenient is the seat next to the door. Sometimes it's impossible. Walking back it would be a matter of using landmarks like the poles, and the people starting to get together at the door.

B. HOW WILL YOU FIND SOMETHING TO HOLD ONTO, AS YOU MOVE TOWARD THE DOOR?

Usually just balance.

C. HOW WILL YOU ACTUALLY LOCATE THE OPEN DOOR?

By sound again, and by the flow of people going out.

D. HOW WILL YOU KNOW WHERE TO PLACE YOUR FOOT AS YOU STEP IN?

With a cane, I would find out if there were steps and whether there were a crack or whether I can just go right ahead.

Topic 13.

A. HOW WILL YOU KNOW WHICH EXIT TO TAKE OUT OF THE STATION?

My own method would be to walk straight, and if I wouldn't ask anyone I would walk straight ahead up to the wall, then usually I would walk to the right until I found someone to ask but sometimes the train is too loud.

IS THERE ANYTHING ELSE YOU WOULD LISTEN FOR?

Anything that could help me, and for steps.

C. IN WHAT DIRECTION WILL YOU GO TO REACH THE EXIT?

I would walk straight ahead until I found the wall, then turn to the right.

E. HOW WILL YOU KNOW HOW TO NEGOTIATE THE TURNSTILE?

With a cane probably, until I knew if I was in front of the turnstile or on the side of the turnstile, and then I would pause a minute, then go through it.

F. HOW WILL YOU KNOW THE GENERAL DIRECTION IN WHICH TO TRAVEL TO REACH THE STAIRS? (ESCALATOR OR ELEVATOR)

I don't think it would be a problem because I could listen for footsteps.

G. HOW WILL YOU ACTUALLY LOCATE THE FIRST RISER? (ESCALATOR OR ELEVATOR)

Again, with the cane.

H. HOW WILL YOU KNOW WHETHER THE STAIRS (ESCALATOR, ELEVATOR) GO UP OR DOWN?

Again, by feeling with the cane whether it's up or a drop.

I. HOW WILL YOU FIND THE HANDRAIL?

By moving to the right or to the left and feeling up or down.

J. HOW WILL YOU KNOW IN WHAT DIRECTION TO TRAVEL FROM THE STAIRS?

By some change in temperature and again, by people...following people.

K. HOW WILL YOU ACTUALLY LOCATE THE EXIT?

Once you reach the exit the sounds are totally different. There is no more echo and it is warmer and the rate and direction of the people.

Topic 14.

A. HOW DO YOU KNOW WHERE YOU ARE, NOW THAT YOU HAVE REACHED THE OUTSIDE OF THE STATION?

Basically, I would know from the instructions I received on the phone. To locate exactly where I am at this moment I would have to listen to traffic and any clue around me. Is this a corner or a small street? Mainly I would use my hearing to find out. I might ask people, like "Is Boylston the street on my right?"

General Topics

Topic A.

I. WHERE (HOW) WOULD YOU FIND A MEN'S (LADIES) ROOM EN ROUTE?

I haven't the faintest idea. I suppose I would ask at the information booth.

Topic B.

1. WHERE (HOW) WOULD YOU FIND A TELEPHONE IF YOU NEEDED TO MAKE A CALL EN ROUTE?

For that I would get close to the exit. That would give me a chance to find a phone whether inside or outside. And then, I would ask anyone. I don't think that would be much of a problem.

Topic C.

1. HOW DO YOU AVOID OBSTACLES AS YOU TRAVEL IN STATIONS OR ON TRAINS?

As I mentioned before, it's a little confusing at the entrance by the turnstiles and information booths. A very important one is in the subway itself, mentioning the name of the station. With the use of a cane and self protector techniques, the use of an arm, and I use a lot of hearing to avoid obstacles.

2. ARE THERE ANY PARTICULAR KINDS OF OBSTACLES WHICH YOU HAVE DIFFICULTY DETECTING AND AVOIDING?

I have difficulty avoiding people and pillars in a subway station.

3. HOW DO YOU AVOID HAZARDS SUCH AS SUDDEN DROPS?

Mainly with good cane technique.

4. ARE THERE ANY PARTICULAR HAZARDS WHICH YOU HAVE DIFFICULTY DETECTING AND AVOIDING?

The only hazard I can think of is knowing how large the gap is between the platform and the car on the rapid transit lines.

Topic E.

1. HOW DO YOU FIND SOMEONE TO ANSWER A QUESTION?

Usually I'll wait for someone to come up to me but if I know there's someone there I'll go up and ask.

ARE THERE ANY OFFICIAL SUBWAY MAPS THAT YOU CAN READ?

The tactile map, once you learn the code, is easy to read.

DO YOU KNOW THE TELEPHONE NUMBER FOR INFORMATION ON THE T?

The only time I used it, I had trouble getting through, but then they were very helpful.

Special Concerns

1. WHAT DO YOU CONSIDER TO BE YOUR THREE MAJOR DIFFICULTIES IN USING THE SUBWAY?

First, counting the stations to be sure I'm at the right station because of the lack of verbal information. Second, knowing how to stand in a good place when the subway comes in. Third, my lack of familiarity with the system - not knowing which lines go where. Also, you can know where the stops are by using the tactile map but you don't know where in the city you are or where the streets are or where the stop will put you out.

2. IF THESE DIFFICULTIES DID NOT EXIST OR WERE NOT AS SEVERE, WOULD YOU BE LIKELY TO USE THE SUBWAY MORE?

Definitely yes.

4. ARE THERE ANY PARTICULAR CHANGES YOU WOULD LIKE TO SEE MADE, WHICH YOU BELIEVE WOULD MAKE YOUR USE OF THE SUBWAY EASIER OR SAFER?

First, the drivers should give more verbal information about what stop they are pulling into or what train they are. Also, the people at the information booth could give more information.
Also, there is a rubber strip along the tracks in some stations like the Auditorium station and that makes me feel safer because I can follow along the strip without getting too close to the edge of the platform.

Subject's Name: Harry H. (Legally Blind - Field Defect)

Interviewer: Judith Sharko

HARRY, HOW WOULD YOU FIND OUT WHAT LINE TO TRAVEL ON AND AT WHAT STATIONS TO GET ON AND OFF?

Well, set up in Philadelphia is an information telephone number. It's VA 9-4800. And there they give out directions and timing, timetables, for the scheduling of trains and buses, and el routes and trolley routes.

HOW WILL YOU FIND THE STATION?

Finding the station....well, I have some knowledge of mobility and the area that I'm travelling in in center city. I would probably ask people, probably, for some assistance, I probably move along with my cane. It's just every day you automatically do it, you just forget right away.

WOULD YOU HAVE YOUR BODY PERHAPS DIRECTED TO THE EXACT ENTRANCEWAY?

Well, that's part of mobility, you specifically learn how to ask directions and if you ask pretty much what corner it might be on....that's something you can ask in the information as far as what routes you would tell.... there is a braille schedule. There's a braille book that (inaudible) puts out. Now it needs to be updated. But the last issue was put out in 1977, and it describes the routes, and it describes which buses are available, directions they go in, that sort of thing.

(QUESTION INAUDIBLE)

I get a lot of cues from a lot of different things, brightly colored objects,that sort of thing.

HARRY, HOW WILL YOU FIND THE ENTRANCE TO THE STATION?

Well, you just heard the coins... you pick up on that...you can hear different things around you....there seems to be a space sound down here. I think initially you just pick up on hearing coins and machines, and where people are walking, you follow them, that sort of thing.

HOW DO YOU KNOW IN WHAT DIRECTION THE STAIRS ARE FROM THE ENTRANCE?

Well, probably the first couple of times I used those stairs after getting from the pay stall, you remember, you just follow along with the people, and if you're really not sure you just can ask the person in front of you, I want to go westbound or the specific direction you want to go.

IN WHAT DIRECTION ARE THE STAIRS FROM THE ENTRANCE?

The stairs in this case were coming down between some spiral stairs. The pay stalls are over to the right. And as you get out of the pay

stall, you make another right. To go westbound, you would have to cross over the tracks. Now to go eastbound these trains travel towards the river, and west is away from the river, towards West Philadelphia. This area of the inner city.

HOW WILL YOU LOCATE THE FIRST RISER?

Well, what happens was, you kind of feel a vibration towards the handle of the cane. And you can feel like a crevice.

IN THIS PARTICULAR SITUATION ARE YOU DOING IT EXCLUSIVELY WITH THE CANE, OR WILL YOU BE USING VISUAL CUES ALSO?

In here, I'll probably be doing it exclusively with a cane, because the slab is white, and the color of the stairs blended with the scheme of the other parts of the station.

HOW WILL YOU KNOW WHETHER THE STAIRS GO UP OR DOWN?

Well, you can feel the indentation of the crevice of the stairway going down and the cane is picking in an upward direction.

HOW WILL YOU FIND THE HANDRAIL, IF YOU USE IT?

I usually don't use the handrail, I depend on the cane and my balance is pretty good. I never need to use it.

HOW DO YOU KNOW IN WHAT DIRECTION THE FARE COLLECTION POINT IS FROM THE ENTRANCE?

You hear change.

OKAY. IN WHAT DIRECTION WILL YOU GO TO REACH THE FARE COLLECTION POINT?

Usually it's, if you go in, sometimes there's fare boxes on each side of the entranceway as you're going in. Now in this case you hear change rattling on the right, so you know it's on the right.

HOW WILL YOU ACTUALLY LOCATE THE FARE COLLECTION POINT?

Now it's on the left. How will I actually locate the fare collection point? I'll just feel with my hand on the top surface, and there's like a, little holes for coins, they go in.

THAT'S HOW YOU WILL NEGOTIATE THE FARE COLLECTION DEVICE, YOU'LL LOCATE THE COIN SLOT?

Right.

HOW OR WHERE COULD YOU GET CHANGE OR ASSISTANCE AT THIS STAGE OF YOUR TRIP?

You could not get change. Everything is exact change. You could always stop at a store on your way down, or go back up and get change.

WHAT ABOUT ASSISTANCE?

In cases when there's nobody around, you'd have to ask the attendant.

HOW DO YOU KNOW IN WHAT DIRECTION YOU SHOULD GO TO WAIT FOR THE TRAIN?

Well, after a while you kind of get the idea what direction you want to go in, and you ask the direction, you know, westbound or eastbound... north, south.....

IN WHAT DIRECTION DO YOU GO TO WAIT FOR THE TRAIN?

Today, if I'm going home, I'm going to go westbound, so I'm going to go out of the pay booth and into the (inaudible) track, and go on the other side, and then go down to where the train will come.

HOW WILL YOU KNOW YOU'RE ON THE RIGHT TRACK?

You get an idea of where you're going. You get an idea in a way, on how the station is set up.

THIS IS A FAMILIAR STATION TO YOU?

Yes.

YOU WOULD KNOW JUST BY VIRTUE OF HAVING HAD ORIENTATION, YOUR ORIENTING YOURSELF TO STATION?

Right, right.

HOW WILL YOU LOCATE A GOOD PLACE TO WAIT FOR THE TRAIN? CONSIDER BOTH DISTANCE FROM THE TRAIN AND POSITION ALONG THE LENGTH OF THE PLATFORM.

Usually you follow people, and you wait around where other people are waiting. And you just, for reassurance, even though you would know, sometimes you ask, you know, am I going westbound.

HOW WILL YOU BE SURE YOU'RE NOT GETTING TOO CLOSE TO THE DROP?

Usually you just come off the down stairway, and usually I'll just walk around the stairway and wait there.

HOW DO YOU KNOW THE TRAIN IS ABOUT TO ARRIVE AT THE STATION?

You can hear it coming up.

HOW WILL YOU KNOW IF THE INCOMING TRAIN IS THE ONE YOU WISH TO TAKE?

Well, on the el, this is only going one direction. There are no other trains that would come along this track. In the train station itself, you'd hear the conductor shout it out or you'd ask a couple of people what train...

HOW DO YOU KNOW THE TRAIN HAS STOPPED AND THE DOORS ARE OPEN, READY FOR YOU TO BOARD?

You can hear it.

HOW WILL YOU LOCATE AN OPEN DOOR?

Well I usually just follow the pattern of the traffic of the people.

HOW DO YOU KNOW WHERE TO PLACE YOUR FOOT WHEN YOU STEP IN? CAN YOU TELL IF THERE IS A GAP OR AN ELEVATION CHANGE?

Well, you can feel with your cane. Use your cane to board.

AS YOU ENTER THE TRAIN, HOW WILL YOU FIND SOMETHING TO HOLD ONTO, TO MAINTAIN YOUR BALANCE?

People are standing here. I can't see from a distance whether all the seats are free....Taking the train every day, you have an idea of the streets. You just passed 13th and now we're going to 15th.

HOW WILL YOU KNOW THE TRAIN IS IN THE STATION?

Well, just by the announcements that are given. Or what particular station you might be at.

HOW WILL YOU KNOW IN WHAT DIRECTION TO SEARCH FOR THE TRAIN DOOR, UPON EXITING?

Usually the conductor, well, he gives the announcement, and usually where he gave the announcement is usually where he's going to be or where the door's going to be.

HOW WILL YOU FIND SOMETHING TO HOLD ONTO AS YOU MOVE TOWARD THE DOOR?

Usually, I'll just go for the poles that are along the side, or the handles of the seats.

HOW WILL YOU ACTUALLY LOCATE THE OPEN DOOR?

It's usually straight ahead and you pass through another opening and the door's to your right, or your left.

YOU'RE USING YOUR CANE?

Right.

WILL YOU ALSO BE USING VISUAL CUES?

A little bit.

HOW WILL YOU KNOW WHERE TO PLACE YOUR FOOT AS YOU STEP OUT?

You use your cane in front of you before you make a step.

HOW WILL YOU KNOW WHAT EXIT TO TAKE OUT OF THE STATION?

Usually if there's a lot, you ask other people, if there's only a couple, you just follow the crowd. And you just move in.

HOW DO YOU KNOW THE GENERAL DIRECTION IN WHICH TO GO, TO REACH THE EXIT YOU WANT TO USE?

You ask people. Tell them you want to get out, and where's the turnstile, how do you get out? You ask.....

HOW WILL YOU KNOW HOW TO NEGOTIATE THE TURNSTILE?

You use your cane to probe for where the turnstile goes around.

HOW WILL YOU KNOW THE GENERAL DIRECTION IN WHICH TO TRAVEL TO REACH THE STAIRS?

Just by memory.

HOW WILL YOU ACTUALLY LOCATE THE FIRST RISER?

Through touch of the cane.

HOW WILL YOU KNOW WHETHER THE STAIRS, ESCALATOR, OR ELEVATOR, GO UP OR DOWN?

Well, usually with your hands, you can feel a little bit, which way it's moving. You get an idea which way the people are moving.

HOW WILL YOU KNOW IN WHICH DIRECTION TO TRAVEL FROM THE STAIRS?

By memory. By the way people are moving.

HOW WILL YOU ACTUALLY LOCATE THE EXIT?

With your cane. Some visual cues, if you see it's getting light, you know you're coming outside, to the outdoors.

HOW DO YOU KNOW WHERE YOU ARE, NOW THAT YOU'VE REACHED THE OUTSIDE OF THE STATION?

...see people...the direction people are moving. By memory. By light, color scheme.

<u>General Topics</u>

<u>Topic A</u>.

1. WHERE (HOW) WOULD YOU FIND A MEN'S (LADIES) ROOM EN ROUTE?

I usually wouldn't. I usually wouldn't use it.

Topic B.

1. WHERE (HOW) WOULD YOU FIND A TELEPHONE IF YOU NEEDED TO MAKE A CALL EN ROUTE?

I would ask.

Topic C.

1. HOW DO YOU AVOID OBSTACLES AS YOU TRAVEL IN STATIONS OR ON TRAINS?

You would have your cane out far enough. You just do.

2. ARE THERE ANY PARTICULAR KINDS OF OBSTACLES WHICH YOU HAVE DIFFICULTY DETECTING AND AVOIDING?

Dark objects. Objects that are, things that are off the ground. Your cane doesn't get these, you miss them.

3. HOW DO YOU AVOID HAZARDS SUCH AS SUDDEN DROPS?

Well, you have your cane out, and that's supposed to tell you a few feet before you get to it.

4. ARE THERE ANY PARTICULAR HAZARDS WHICH YOU HAVE DIFFICULTY DETECTING AND AVOIDING?

Right off hand, I can't think of any.

Topic D.

1. ASSUMING YOU KNOW WHERE YOU WANT TO GO TO NEGOTIATE OPEN AREAS IN A STATION, HOW DO YOU ESTABLISH YOUR TRAVEL DIRECTION AND MAINTAIN A STRAIGHT LINE OF TRAVEL?

That's something that you learn when you take mobility...(inaudible section)...I have an idea how the station is set up. There's a center platform and those elevated trains are on both sides. Stairways are on the middle platform. The wall to the stairway is not far from the track so you come to it right away.

Topic E.

1. HOW DO YOU FIND SOMEONE TO ANSWER A QUESTION?

(Inaudible)...I might hear people.

2. HOW DO YOU FIND SOMEONE TO GUIDE YOU, IF NECESSARY?

I use the (inaudible)...leading, I'm behind them.

IF THERE WEREN'T SOMEONE STANDING NEARBY WHAT WOULD YOU DO?

Probably wait till I do hear somebody. Try to look if I could. Whatever I see.

3. HOW DO (CAN) YOU FIND A MAP THAT YOU CAN READ?

(Inaudible).

--WHAT ABOUT ON THE VISUAL (INAUDIBLE)?

I can't read maps. Maps rare very hard for me to follow. Actually doing, going on mobility, or...

4. WHAT ARE YOUR PROBLEMS IN USING AVAILABLE MAPS?

No problems. Not very many are available.

Topic F.

1. HOW WOULD YOU KNOW THERE WAS AN EMERGENCY?

I should probably hear a lot of excitement from the people, you probably hear announcements being given. There's a lot of pushing and shoving, rushing, that sort of thing.

2. HOW WOULD YOU KNOW WHERE TO GO, OR WHAT TO DO?

I'd probably...the first thing is try to stay calm. If I were thinking correctly in that situation, I would have the ability to make decisions, that sort of thing, and hope for the best. The subway is not a very safe system. There are a lot of (inaudible), a few fires (inaudible).

(Inaudible section).

Topic G.

1. (QUESTION INAUDIBLE)

There's not a regular fare. You get a reduced fare, being that you're blind. You can't use it during rush hour...(inaudible)...you have to use it at off-peak hours.

2. HAVE YOU EVER USED THE SCHEDULE IN BRAILLE?

Just a few times. The Braille did not help much with me.

4. IF YOU DID NOT HAVE THIS ADAPTATION, WOULD YOUR TRAVEL BE MORE DIFFICULT OR LESS SAFE?

I'm sure it isn't any for me. I don't really make too much use of it. I usually call information or ask somebody that I know. I know a few of the drivers and you get to know people as you use the system.

Special Concerns

1. WHAT DO YOU CONSIDER TO BE YOUR THREE MAJOR DIFFICULTIES IN USING THE SUBWAY?

Some stations aren't lit very well. The Keys-Dixon stations are awful. Sometimes it's hard because the acoustics are so bad. I wouldn't....

2. IF THESE DIFFICULTIES DID NOT EXIST OR WERE NOT AS SEVERE, WOULD YOU BE LIKELY TO USE THE SUBWAY MORE?

Well, maybe, yes, if you feel more comfortable using it, your skill would, you would feel a little bit more independent, you could feel better.

3. ARE THERE SOME TIMES OR SITUATIONS IN WHICH YOU SIMPLY WOULD NOT USE THE SUBWAY, EVEN THOUGH IT WAS, FOR NON-VISUALLY IMPAIRED TRAVELLERS, THE FASTEST WAY TO REACH YOUR DESTINATION?

Probably late at night on some of the subway. I probably would not use the (inaudible) line. That's a high-crime area. Everywhere you go you take a risk. In getting out of bed...Some parts of the city are high crime.

4. ARE THERE ANY PARTICULAR CHANGES YOU WOULD LIKE TO SEE MADE, WHICH YOU BELIEVE WOULD MAKE YOUR USE OF THE SUBWAY EASIER OR SAFER?

Some of the stations have (inaudible)...frequency or time that the trains come is less than...I think more trains could be put on at certain times.

Subject's Name: Mimi W. (Legally Blind - Acuity Problem)

Interviewer: Vicky Berg

Topic 1.

A. HOW WOULD YOU FIND OUT WHAT LINE TO TRAVEL ON, AND AT WHICH STATIONS TO GET ON AND OFF?

I'd try to call up the MBTA ahead of time, first, to find that out.

--HAVE YOU HAD SUCCESS USING THAT METHOD?

No, I haven't bothered to use it. I've only been travelling on routes that I've known.

Topic 2.

A. HOW WILL YOU FIND THE STATION?

I'd ask somebody where it was.

--A PEDESTRIAN, OR...

Yes.

Topic 3.

A. HOW WILL YOU FIND THE ENTRANCE TO THE STATION?

I can see the entrance.

--WHAT ABOUT THE ENTRANCE CAN YOU SEE?

I can see somebody coming up, so I know it's going to come down, because I can see somebody ascending. I see two poles.

--DO YOU SEE ANY SIGNS?

No, I know there's a sign up there but I can't see it.

Topic 4.

A. AND YOU KNOW IN WHAT DIRECTION THE STAIRS ARE BECAUSE YOU SAW SOMEBODY COMING UP THEM?

Yes.

C. HOW WILL YOU LOCATE THE FIRST RISER?

With my cane.

D. HOW WILL YOU KNOW WHETHER THE STAIRS GO UP, OR DOWN?

I know they go down, I saw someone coming up.

--DO YOU USE A HANDRAIL WHEN YOU GO DOWNSTAIRS?

Sometimes I do, sometimes I don't. I prefer a handrail, but I don't trust them because sometimes they're not totally with the stairs themselves. They're cut off earlier. So I don't trust the handrail, but I prefer it.

--THE RAIL MAY STOP BEFORE THE STAIRS DO?

Yes. I often have a lot of stuff in my arms.

E. HOW WILL YOU FIND THE HANDRAIL, IF YOU USE IT?

I suppose by moving my cane to the edge of the stairs, till I found it.

--YOU MENTIONED THERE WAS A PROBLEM WITH THE HANDRAIL ON THE STAIRS YOU JUST CAME DOWN.

Yes, it was absent in certain areas.

ON THE LANDING BETWEEN TWO FLIGHTS, THERE WAS NO RAIL AT ALL. SO YOU MIGHT NOT HAVE EVEN KNOWN IF THERE WERE MORE STAIRS COMING UP, IF YOUR CANE HAD NOT...

Right.

Topic 5.

B. IN WHAT DIRECTION WILL YOU GO TO REACH THE FARE COLLECTION POINT?

In front of me.

--HOW DO YOU KNOW THAT?

It's darker there, there's a blob there. There's nothing over there.

WE'RE AT THE END OF THE STATION?

Yes.

C. HOW WILL YOU ACTUALLY LOCATE THE FARE COLLECTION POINT?

I'm not sure how I will. I'll hear someone or something. Usually it's in a box like what's in front of us. That big thing. Whatever that is.

E. HOW OR WHERE COULD YOU GET CHANGE OR ASSISTANCE AT THIS STAGE OF YOUR TRIP?

I'd have to go till I found somebody.

Topic 6.

A. HOW DO YOU KNOW IN WHAT DIRECTION YOU SHOULD GO TO WAIT FOR THE TRAIN?

I can see it and I also can hear the trains.

--WHAT ABOUT THE TRACK CAN YOU SEE?

I can see the yellow line.

C. HOW WILL YOU KNOW YOU ARE ON THE RIGHT TRACK?

I'd have to ask.

E. HOW WILL YOU BE SURE YOU'RE NOT GETTING TOO CLOSE TO THE DROP?

The yellow line. I also always watch other people. I would never travel alone in here. I would wait till someone else was coming.

--HAVE YOU EVER BEEN IN A SUBWAY STATION, AND THE YELLOW LINE HAS BEEN DIRTY OR WHATEVER...

I've never bothered to notice. Usually I have a sense of other people around, and stay behind them.

D. HOW WILL YOU LOCATE A GOOD PLACE TO WAIT FOR THE TRAIN (CONSIDER BOTH DISTANCE FROM TRAIN AND POSITION ALONG LENGTH OF PLATFORM)?

I usually wait for other people, or I listen to where the doors are. But I tend to listen to other people.

Topic 8.

A. HOW WILL YOU KNOW WHETHER THE INCOMING TRAIN IS THE ONE YOU WISH TO TAKE?

I'll have already found out where I want to go.

Topic 9.

A. HOW WILL YOU KNOW THE TRAIN HAS STOPPED AND THE DOORS ARE OPEN, READY FOR YOU TO BOARD?

I can hear them.

--CAN YOU SEE ANYTHING ABOUT THEM AS THEY OPEN?

Sometimes I can. Not always.

B. HOW WILL YOU LOCATE AN OPEN DOOR?

I usually wait for the crowd and go with them.

C. HOW DO YOU KNOW WHERE TO PLACE YOUR FOOT AS YOU STEP IN? (CAN YOU TELL WHETHER THERE IS A GAP OR AN ELEVATION CHANGE?)

I would with my cane. Sometimes I can see other people going up or down. Basically I would use my cane for that.

Topic 10.

A. AS YOU ENTER THE TRAIN, HOW WILL YOU FIND SOMETHING TO HOLD ONTO, TO MAINTAIN YOUR BALANCE?

I still probably have enough vision to do that. But I know there are grips on all the chairs. The up ones, I'm not sure how I would do it. I can always grip a chair. Can always ask somebody.

--CAN YOU THINK OF ANY WAY THEY COULD CHANGE THE COLOR OR THE TEXTURE OF THE POLES, TO MAKE IT EASIER TO SEE THEM?

I'm sure if they had them in a luminescent type thing, or a rough type thing, it would help, both.

--WOULD YOU LOOK FOR A SEAT, GOING ONLY ONE STOP?

No, I'd stay near the door.

B. HOW WILL YOU FIND A SEAT?

I'd probably have enough sight to do that, and if I didn't I'd ask.

Topic 11.

B. HOW WILL YOU KNOW THE TRAIN IS IN THE STATION?

I'd have to ask, or know there were ten stops, or something like that.

Topic 12.

A. HOW WILL YOU KNOW IN WHAT DIRECTION TO SEARCH FOR THE TRAIN DOOR?

You hear it.

C. HOW WILL YOU ACTUALLY LOCATE THE OPEN DOOR?

I can hear it, sense it, I know, I somewhat see it.

D. HOW WILL YOU KNOW WHERE TO PLACE YOUR FOOT AS YOU STEP OUT?

I'd use my cane to pick up the drop-off.

Topic 13.

A. HOW WILL YOU KNOW WHICH EXIT TO TAKE OUT OF THE STATION?

It depends on which side I wanted to exit on, and if there was more than one exit. What side of the street I wanted to be on. In Boston, there are several ways you can get out and it lands you in different places. So I'd have to ask.

--WHAT IF THERE WERE NO ONE AROUND?

Then I'd just find an exit. I'd go out in the openings till I found one.

B. HOW DO YOU KNOW THE GENERAL DIRECTION IN WHICH TO GO, TO REACH THE EXIT YOU WANT TO USE?

I can usually find an opening with my cane and know that I'm not hitting against something, and just keep going until there was an obstruction. If there was an obstruction, I'd have to turn around and find another opening.

--DO YOU HAVE ANY SENSORY INFORMATION RIGHT NOW THAT WOULD HELP YOU KNOW WHERE TO GO TO GET TO THE EXIT?

Yes. I can feel cold coming in from up there somewhere.

--ANYTHING ELSE?

Yes, somebody just came in. So it's probably an opening.

D. HOW WILL YOU ACTUALLY FIND THE EXIT TURNSTILE (OR OTHER DEVICE)?

With my cane, or listening to other people move.

F. HOW WILL YOU KNOW THE GENERAL DIRECTION IN WHICH TO TRAVEL TO REACH THE STAIRS? (ESCALATOR OR ELEVATOR)

With my cane, and watching or feeling other people move out, cold air.

(Discussion about a large print sign) The print is excellent. Best print I've ever seen.

THE CONTRAST IS GOOD?

I don't even bother noticing them because I always figure I can't read them. If you put it up high, then I couldn't read this.

--NO SMOKING SIGN.

This is excellent print. Really excellent for a low vision person. Superb. I'm a 20/400. I can't read it with the other eye. I can barely make it out.

PART OF THOSE LETTERS ARE OBSCURED BY A SIGN. THIS SIGN THAT WE ARE LOOKING AT IS OF THE WHOLE T SYSTEM. TO THE RIGHT OF IT...

Okay, if you're interested with this sign, I can read the "Rapid Transit", which is in larger print.

OKAY, ABOUT AN INCH HIGH. BOLD LETTERS.

They're beautiful.

TO THE RIGHT OF THIS SIGN IS A SIGN THAT SHOWS JUST THE RED LINE. CAN YOU READ THIS ONE?

Kendall, Charles, Park. Yes, again, it's not good--it's poor lighting.

IT'S A GREAT SIGN BUT THE LIGHTING IS POOR.

My suggestion is some kind of indirect fluorescent lighting, not glaring on it, but away from it. Not on it, it will bleach it out.

AND THIS IS A VERY SMOOTH SURFACE, SO IT WOULD GLARE IF IT WERE DIRECTED.

But that's my problem. It may not be someone else's.

MANY PEOPLE NEED MORE LIGHT. WERE YOU AWARE OF THESE SIGNS?

Not really. I would not see them unless someone pointed them out to me. Would it be helpful to have Braille overlays on these? Not for me, but for other people.

THAT'S A GOOD IDEA TO RESEARCH.

Or if you had your very large letters raised, people could feel them.

THAT MIGHT BE COVERED BY HAVING THE TACTILE-GRAPHIC MAPS OF THE T.

Ones you carry?

YES. THE ADVANTAGE OF THEM IS THAT THEY'RE PORTABLE.

I can't use them. I've tried and they're very confusing to me.

DO YOU THINK THAT IF PRINT MAPS OF THIS SIZE WERE MADE UP ON PAPER RATHER THAN ON METAL....

These are fabulous. Terrific. I feel that 80% of blind people can read. I never even knew these were around. We went from Central to Kendall? I'm not very good at map-reading. Now I know exactly where I am. That's terrific. How are - who's going to make a great big map like that?

IT COULD BE A PHOTOGRAPH, A POSTER.

To carry around?

NO, TO POST AT HOME AND PLAN A TRIP.

I tend not go go on subways at all because I only go where I went as a sighted person. I know the Green Line and I'm comfortable. I would never tend to come here alone, it would be very difficult. I would be reluctant. But if I had a map like that, I wouldn't be the least bit reluctant.

IN NEW YORK CITY, INSTEAD OF HAVING THESE METAL SIGNS, THEY HAVE BIG PAPER POSTERS, A LARGE-PRINT SUBWAY MAP.

Even if you had to buy it, it would be worth it.

WE COULD GET THEM FREE FROM THE PUBLIC RELATIONS DEPARTMENT. WHAT THE TRANSIT SYSTEM THERE DID EVERY COUPLE OF MONTHS, THEY WOULD JUST POST UP A NEW ONE.

For the non-totally blind.

RIGHT. WE WERE ABLE TO GET FREE PAPER MAPS.

I think it would hit 80% of the people. Because even for the eye that hardly works, I could probably study it at home and make it work. That's really terrific. How would someone go and find one of these? You'd have to ask someone where's the map?

YOU PROBABLY WOULD. THEY'RE USUALLY LOCATED NEAR THE INFORMATION BOOTH. THERE'S USUALLY ONE ON EACH SIDE.

I've never seen one before. They're terrific.

YOU'RE A GOOD EXAMPLE. YOUR VISION IS CHARACTERISTIC OF MANY PEOPLE. THEY CAN SEE SOMETHING ONCE THEY FIND IT. BUT THEN YOU WOULD NEED HELP IN FINDING IT. THEY WOULD NEED TO HAVE IT BETTER LOCATED, OR MORE CONSISTENTLY LOCATED.

Did you find this was true of most people, they didn't know these were here?

YES.

Did they find they were useful?

YES.

Now where's the Green Line for instance. That's the one I do travel the most. Is it on here?

HOW ARE THE COLORS AS FAR AS CONTRAST?

This is it, isn't it.

YES.

Science Park, Lechmere, North Station, Haymarket. Sometimes I stop doing it because I'm chicken. I know how to get to Park Street, and then

I have to go underground to get down to the Mass. Eye and Ear, which is at Charles Street. So I'd have to take the Red Line. This is where we are. We would just continue on that...

HOW DO YOU KNOW THIS IS UP?

I can see the light.

CAN YOU SEE THE EDGES AND THE CONTRAST STRIP?

Yes.

MIMI POINTED OUT ONE OF THE BIGGEST PROBLEMS. THERE ARE STRIPES ON EVERY STEP EXCEPT THE TOP STEP.

Why?

I DON'T KNOW. BUT THAT WOULD MAKE SOMEBODY BREAK A LEG. BECAUSE IT IS MISLEADING INFORMATION BECAUSE YOU CAN SEE THE STRIPES AND YOU DEPEND ON THE VISUAL INFORMATION...WOULD IT BE BETTER AS FAR AS SAFETY IF THE STEPS DID NOT HAVE WHITE STRIPS RATHER THAN HAVE EVERY ONE EXCEPT THE TOP ONE WHITE?

Oh, I agree. I would say not steps rather than do that. That's a real (inaudible). Can you see what it was? Has anyone else mentioned it to you?

NOT PARTICULARLY THAT. THAT WAS THE TOP STEP OF THE LOWER STAIR FLIGHT. LET'S SEE...THE TOP STEP OF THE STREET-LEVEL FLIGHT OF STAIRS IS NOT MARKED, THE NEXT ONE DOWN IS MARKED....WE'RE DESCENDING AT KENDALL ON THE OUTBOUND SIDE. ON THE TOP FLIGHT OF STAIRS, THERE ARE THE WHITE STRIPS ON THE EDGES OF THE STEPS ALL EXCEPT FOR THE TOP STEP ON THE UPPER FLIGHT OF STAIRS, AND THERE WERE NO MARKINGS ON THE LOWER FLIGHT OF STAIRS. THESE WHITE STRIPS ON THE EDGES OF THE STAIRS ARE HARDER TO SEE. THAT'S JUST BECUASE THEY ARE DIRTIER. THEIR CONTRAST IS NOT QUITE AS GOOD. PROBABLY THEY WOULD BE BETTER IN YELLOW. YELLOW AND BLACK.

Topic 14.

A. HOW DO YOU KNOW WHERE YOU ARE, NOW THAT YOU'VE REACHED THE OUTSIDE OF THE STATION?

Hopefully the sun would be out for me. That's very helpful to me for orientation. If the sun wasn't out I might have to ask directions.

General Topics

Topic A.

1. WHERE (HOW) WOULD YOU FIND A MEN'S (LADIES) ROOM EN ROUTE?

In the subway area? I'd hold it in. I wouldn't consider using it in the subway.

Topic B.

1. WHERE (HOW) WOULD YOU FIND A TELEPHONE IF YOU NEEDED TO MAKE A CALL EN ROUTE?

I would ask.

--WHO WOULD YOU ASK?

One of the officials, if I could find one. In the booth. If not, I'd just have to ask a passerby.

Topic C.

2. ARE THERE ANY PARTICULAR KINDS OF OBSTACLES WHICH YOU HAVE DIFFICULTY DETECTING AND AVOIDING?

Yes, I have trouble with stairs. I manage them but I find that they're obstacles.

--AND TODAY WE SAW ONE REASON THAT...

Because they didn't have the stairs painted consistently and the railings are not consistent.

--DO YOU HAVE ANY CONCERNS ABOUT THE EDGE OF THE PLATFORM?

Yes, but I shy away from the edge of the platform.

SO YOU WOULD STAY, USE THE PEOPLE?

I use people and also sometimes markings.

--DO YOU FIND THAT YOUR CANE TECHNIQUE WORKS FOR YOU IN PREVENTING CONTACT WITH OBSTACLES?

Pretty well. It helps.

Topic E.

1. HOW DO YOU FIND SOMEONE TO ANSWER A QUESTION?

Well, first I would look for an official, in one of the booths. If I couldn't I'd ask a passerby if they could help.

3. HOW DO (CAN) YOU FIND A MAP THAT YOU CAN READ?

I just found one today with the aid of you.

--AND THAT MAP YOU WERE ABLE TO READ?

Yes.

--YOU GAVE AN ESTIMATE THAT IT MIGHT BE READABLE BY 80% OF LEGALLY BLIND PEOPLE.

If the lighting were better.

4. WHAT ARE YOUR PROBLEMS IN USING AVAILABLE MAPS?

I can't read them, they are not well-defined. They are too small.

Topic F.

1. HOW WOULD YOU KNOW THERE WAS AN EMERGENCY?

Somebody calls it out, the conductor says so.

2. HOW WOULD YOU KNOW WHERE TO GO, OR WHAT TO DO?

I would probably try to follow the other people. Ask someone to sort of guide me if I were really having a problem. To let me go with them.

Topic G.

2. HAVE YOU EVER USED THE TACTILE GRAPHIC SUBWAY MAP?

Yes, I don't like it.

--DO YOU KNOW WHY YOU DON'T LIKE IT?

It's too confusing for me. I can't handle it.

YOU CAN'T HANDLE IT TACTILELY. VISUALLY?

Visually, it's not as clear. It's got too many things on it.

Special Concerns

1. WHAT DO YOU CONSIDER TO BE YOUR THREE MAJOR DIFFICULTIES IN USING THE SUBWAY?

I don't know where I'm going, or where I'm going to come out, which side of the subway is going to come out and which street it's going to land on. I wouldn't, for example, today, know that you had one going in and one going out. You know, like where we were today? That you had to come in

one way and go out another, things like that. If I came back from the doctor's office, let's say, and were going, I would assume I should go back to the place that I came out of. And I find that I couldn't.

THERE ARE PRINT SIGNS THAT SAY "INBOUND" OR "OUTBOUND". BUT THOSE ARE NOT LEGIBLE TO YOU?

No.

ANY OTHER DIFFICULTIES THAT YOU WOULD CONSIDER TO BE KEEPING YOU FROM USING THE SUBWAY MORE?

It's just scary, difficult, especially in new situations. It's all right on the old line I'm comfortable with.

THE GREEN LINE.

Yes. And in a new situation I would feel more comfortable going a couple of times with someone else until I felt at home there. But I don't have that opportunity usually. Because if I did that I might as well use them as a dog...You know what I mean.

3. ARE THERE SOME TIMES OR SITUATIONS IN WHICH YOU SIMPLY WOULD NOT USE THE SUBWAY, EVEN THOUGH IT WAS, FOR NON-VISUALLY IMPAIRED TRAVELLERS, THE FASTEST WAY TO REACH YOUR DESTINATION?

I'd probably use it. It's never been the fastest way.

MAINLY BECAUSE OF LACK OF FAMILIARITY?

It's a hell of a lot faster to go and get a ride for me particularly, where I live in Wayland.

OKAY, THAT IS ANOTHER FACTOR. YOU ARE NOT LIVING VERY NEAR THE SUBWAY. LAST QUESTION. ARE THERE ANY PARTICULAR CHANGES YOU WOULD LIKE TO SEE MADE, WHICH YOU BELIEVE WOULD MAKE OUR USE OF THE SUBWAY EASIER OR SAFER?

I think better lighting everywhere. At least one attendant at every entrance and exit at every station would make it more reassuring.

WHAT COULD THE T DO TO MAKE IT EASIER FOR YOU TO LOCATE THAT PERSON?

Have him at the main place, where you come in or out. So every entrance or exit has somebody to ask questions of.

ANYTHING ELSE YOU CAN THINK OF?

No.

APPENDIX G

INTERVIEW INSTRUMENT USED IN TELEPHONE INTERVIEWS

OF VISUALLY IMPAIRED TRAVELLERS

Telephone Survey - Instructions to Subjects

What I am going to do now is to ask you about several issues concerning your use of rail rapid transit. I will ask a question about an issue, and I would like you to tell me if the issue is a very major problem for you, a major problem, a problem, a minor problem, or no problem at all. For example, if I asked you if the weather in (Boston/Philadelphia/ Atlanta) was a hazard to your use of rail rapid transit, you might say it was a very major problem if the snow and ice is never cleared during the winter and you have fallen in a station, a major problem if high winds or drafts frequently make it difficult to hear train announcements, a problem if stations have puddles when it rains which sometimes make it difficult for you to orient yourself, a minor problem if glare from bright sun makes you walk slowly, and no problem if the weather generally presents no special difficulties for you. If you would like to make a brief comment about an issue, that is fine, but there are several issues I wish to ask you about, so I ask that you consider your answer for a moment, then rate the issue, and then briefly explain your answer if you like. You will have an opportunity to comment on other issues in the end. Do you have any questions before we begin?

Questions

(Randomize the order of Questions 1-7.)

1. Is planning a route a problem for you, in terms of knowing what line to travel on, and at what stations to begin and end your journey? You might, for example, have to ask someone, or call an information line, or read a map in order to plan.

2. Do you have a problem identifying the entrance to a familiar station once you have found it? For example, is there a sign or a consistent architectural feature which you can use?

ALT.*

3. Do stairs in the stations present a problem for you in terms of such things as locating them, using them, or finding handrails?

ALT.

4. Is locating a fare collection device a problem for you? You may, for example, ask someone for help or go to an information booth.

ALT.

5. Is using the fare collection device a problem for you? For instance, do you have much trouble finding the slot for your fare or getting a transfer?

ALT.

6. Is locating the right train a problem for you? That is, are you able to identify the train you want among all the tracks in the station?

ALT.

7. Is locating a safe and correct place to wait for the train a problem for you? For example, are you afraid of falling off the platform?

ALT.

(Randomize the order of Questions 8-12.)

8. Is locating an open door on a train a problem for you?

9. Is boarding a train a problem for you? For example, does the gap between the door and the platform present a problem, or do crowds present a problem when boarding?

10. Is finding an empty seat (assuming there are some) a problem for you?

11. Is knowing whether or not the next stop is yours a problem for you?

8* ALT. = Same question, unfamiliar station

12. Is exiting the train a problem for you? For example, can you find the exit door, and do you know where to place your foot when you exit?

(Randomize the order of Questions 13-17.)

13. Is finding and using the exit turnstile or gate a problem for you?

ALT.

14. Is locating the station exit you want a problem for you?

ALT.

15. Does high contrast between sun and shadow cause a problem for you at elevate or ground level stations?

ALT.

16. Would finding a rest room inside a station present a problem for you?

ALT.

17. If there were an emergency in a station, such as a fire or a crash, would it be a problem for you to exit the station quickly?

ALT.

I. Are there any major problems that you experience when attempting to use rail rapid transit that I have not mentioned?

II. Have you noticed any particular obstacles or hazards either in stations or on trains which you have difficulty detecting or avoiding?

III. Which type of station is most difficult for you to use?

Elevated Ground level Subway No major difference

---Why?

IV. Which type of station is easiest for you to use?

Elevated Ground level Subway No major difference

---Why?

V. Do you have a problem using the signs in familiar stations?

ALT.

VI. Do you have a problem using the announcements in stations?

VII. Do you have a problem using the announcements on trains?

VIII. Do you have a problem using the telephone information system?

IX. How long have you been using rail rapid transit?

APPENDIX H

REACTIONS OF VISUALLY IMPAIRED AND NORMALLY SIGHTED SUBJECTS TO POTENTIAL SOLUTIONS ACCORDING TO AGE

Estimates of consumer reaction to certain of the proposed solutions to problems encountered by the visually impaired in negotiating rapid rail were presented in Chapter 5. These estimates were obtained from the results of questionnaires administered to visually impaired and normally sighted users of rapid rail. The tables below present a second order of analysis according to three separate age categories. Question numbers at the left of each table correspond to the items contained in the two questionnaires (see Chapter 5).

Table H-1

Percentage of Blind Respondents Selecting Each Response Category, by Question and by Age

Q.#	Resp.	12-21	22-50	over 50	Q.#	Resp.	12-21	22-50	over 50
1.)	SA	100.0	93.3	100.0	5.)	SA	57.1	60.0	75.0
	SWA	0.0	6.7	0.0		SWA	28.6	26.7	0.0
	MF	0.0	0.0	0.0		MF	0.0	6.7	25.0
	SWD	0.0	0.0	0.0		SWD	14.3	6.7	0.0
	SD	0.0	0.0	0.0		SD	0.0	0.0	0.0
Column Total		29.6	55.6	14.8	Column	Total	26.9	57.7	15.4
2.)	SA	62.5	80.0	100.0	6.)	SA	80.0	100.0	100.0
	SWA	25.0	13.3	0.0		SWA	20.0	0.0	0.0
	MF	0.0	6.7	0.0		MF	0.0	0.0	0.0
	SWD	12.5	0.0	0.0		SWD	0.0	0.0	0.0
	SD	0.0	0.0	0.0		SD	0.0	0.0	0.0
Column Total		29.6	55.6	14.8	Column	Total	26.3	52.6	21.1
3.)	SA	75.0	80.0	100.0	7.)	SA	80.0	90.0	100.0
	SWA	25.0	13.3	0.0		SWA	20.0	10.0	0.0
	MF	0.0	6.7	0.0		MF	0.0	0.0	0.0
	SWD	0.0	0.0	0.0		SWD	0.0	0.0	0.0
	SD	0.0	0.0	0.0		SD	0.0	0.0	0.0
Column Total		29.6	55.6	14.8	Column	Total	26.3	52.6	21.1
4.)	SA	25.0	46.7	100.0	8.)	SA	80.0	50.0	100.0
	SWA	62.5	26.7	0.0		SWA	20.0	30.0	0.0
	MF	12.5	13.3	0.0		MF	0.0	10.0	0.0
	SWD	0.0	13.3	0.0		SWD	0.0	10.0	0.0
	SD	0.0	0.0	0.0		SD	0.0	0.0	0.0
Column Total		29.6	55.6	14.8	Column	Total	26.3	52.6	21.1

SA - Strongly Agree
SWA - Somewhat Agree
MF - Mixed Feelings
SWD - Somewhat Disagree
SD - Strongly Disagree

(continued)

Table H-1
Percentage of Blind Respondents Selecting Each Response Category, by Question and by Age
(continued)

Q.#	Resp	12-21	22-50	over 50	Q.#	Resp	12-21	22-50	over 50
9.)	SA	37.5	66.7	75.0	13.)	SA	85.7	93.3	100
	SWA	37.5	26.7	25.0		SWA	14.3	0.0	0.0
	MF	12.5	0.0	0.		MF	0.0	6.7	0.0
	SWD	12.5	0.0	0.0		SWD	0.0	0.0	0.0
SD	SD	0.0	6.7	0.0		SD	0.0	0.0	0.0
Column Total-		29.6	55.6	14.8	Column Total-		26.9	57.7	15.4
10.)	SA	28.6	46.7	75.0	14.)	SA	100.	100.	100
	SWA	28.6	33.3	0.0		SWA	0.0	0.0	0.0
	MF	14.3	13.3	0.0		MF	0.0	0.0	0.0
	SWD	28.6	0.0	25.0		SWD	0.0	0.0	0.0
	SD	0.0	6.7	0.0		SD	0.0	0.0	0.0
Column Total-		26.9	57.7	15.4	Column Total-		22.2	55.6	22.2
11.)	SA	50.0	63.6	75.0	15.)	SA	12.5	21.4	75.0
	SWA	50.0	27.3	25.0		SWA	75.0	21.4	25.0
	MF	0.0	0.0	0.0		MF	0.0	28.6	0.0
	SWD	0.0	0.0	0.0		SWD	12.5	7.1	0.0
	SD	0.0	6.7	0.0		SD	0.0	21.4	0.0
Column Total-		21.1	57.9	21.1	Column Total-		30.8	53.8	15.4
12.)	SA	62.5	86.7	75.0	16.)	SA	42.9	28.6	75.0
	SWA	37.5	6.7	25.0		SWA	42.9	21.4	25.0
	MF	0.0	0.0	0.0		MF	14.3	21.4	0.0
	SWD	0.0	0.0	0.0		SWD	0.0	14.3	0.0
	SD	0.0	6.7	0.0		SD	0.0	14.3	0.0
Column Total-		29,6	55.6	14.8	Column Total-		28.0	56.0	16.0

SA - Strongly Agree
SWA - Somewhat Agree
MF - Mixed Feelings
SWD - Somewhat Disagree
SD - Strongly Disagree

(continued)

Table H-1
Percentage of Blind Respondents Selecting Each Response Category, by Question and by Age
(continued)

Q.#	Resp.	12-21	22-50	over 50	Q.#	Resp	12-21	22-50	over 50
17.)	SA	42.9	35.7	75.0	21.)	SA	50.0	7.1	75.0
	SWA	42.9	14.3	25.0		SWA	37.5	35.7	25.0
	MF	14.3	21.4	0.0		MF	12.5	14.3	0.0
	SWD	0.0	14.3	0.0		SWD	0.0	14.3	0.0
	SD	0.0	14.3	0.0		SD	0.0	28.6	0.0
Column	Tota -	28.0	56.0	16.0	Column	Total-	30.8	53.8	15.4
18.)	SA	42.9	42.9	75.0	22.)	SA	50.0	20.0	75.0
	SWA	42.9	7.1	25.0		SWA	12.5	26.7	25.0
	MF	0.0	28.6	0.0		MF	25.0	33.3	0.0
	SWD	14.3	7.1	0.0		SWD	12.5	0.0	0.0
	SD	0.0	14.3	0.0		SD	0.0	20.0	0.0
Column	Total-	28.0	56.0	16.0	Column	Total-	29.6	55.6	14.8
19.)	SA	85.7	35.7	75.0	23.)	SA	25.0	13.3	75.0
	SWA	14.3	21.4	25.0		SWA	37.5	13.3	25.0
	MF	0.0	14.3	0.0		MF	25.0	26.7	0.0
	SWD	0.0	7.1	0.0		SWD	12.5	20.0	0.0
	SD	0.0	21.4	0.0		SD	0.0	26.7	0.0
Column	Total-	28.0	56.0	16.0	Column	Total-	29.6	55.6	14.8
20.)	SA	42.9	28.6	75.0	24.)	SA	100.0	25.0	100.0
	SWA	28.6	21.4	25.0		SWA	0.0	25.0	0.0
	MF	14.3	21.4	0.0		MF	0.0	37.0	0.0
	SWD	14.3	14.3	0.0		SWD	0.0	0.0	0.0
	SD	0.0	14.3	0.0		SD	0.0	12.5	0.0
Column	Total-	28.0	56.0	16.0	Column	Total-	29.4	47.1	23.5

SA - Strongly Agree
SWA - Somewhat Agree
MF - Mixed Feelings
SWD - Somewhat Disagree
SD - Strongly Disagree

(continued)

Table H-1
Percentage of Blind Respondents Selecting Each Response Category, by Question and by Age
(continued)

Q.#	Resp.	12-21	22-50	over 50	Q.#	Resp.	12-21	22-50	over 50
25.)	SA	100.0	60.0	100.0	29.)	SA	14.3	0.0	50.0
	SWA	0.0	10.0	0.0		SWA	28.6	14.3	0.0
	MF	0.0	20.0	0.0		MF	14.3	21.4	0.0
	SWD	0.0	0.0	0.0		SWD	28.6	28.6	50.0
	SD	0.0	10.0	0.0		SD	14.3	35.7	0.0
Column	Total-	27.8	55.6	16.7	Column	Total-	28.0	56.0	16.0
26.)	SA	80.0	66.7	100.0	30.)	SA	85.7	73.3	50.0
	SWA	20.0	11.1	0.0		SWA	14.3	20.0	25.0
	MF	0.0	22.2	0.0		MF	0.0	6.7	0.0
	SWD	0.0	0.0	0.0		SWD	0.0	0.0	0.0
	SD	0.0	0.0	0.0		SD	0.0	0.0	25.0
Column	Total-	27.8	50.0	22.2	Column	Total-	26.9	57.7	15.4
27.)	SA	71.4	53.8	100.0	31.)	SA	62.5	40.0	75.0
	SWA	14.3	23.1	0.0		SWA	12.5	20.0	25.0
	MF	0.0	15.4	0.0		MF	12.5	20.0	0.0
	SWD	0.0	7.7	0.0		SWD	12.5	13.3	0.0
	SD	14.3	0.0	0.0		SD	0.0	6.7	0.0
Column	Total-	29.2	54.2	16.7	Column	Total-	29.6	55.6	14.8
28.)	SA	75.0	26.7	100.0	32.)	SA	14.3	0.0	75.0
	SWA	12.5	33.3	0.0		SWA	28.6	20.0	0.0
	MF	0.0	20.0	0.0		MF	14.3	20.0	0.0
	SWD	0.0	6.7	0.0		SWD	28.6	33.3	25.0
	SD	12.5	13.3	0.0		SD	14.3	26.7	0.0
Column	Total-	29.6	55.6	14.8	Column	Total-	26.9	57.7	15.4

SA - Strongly Agree
SWA - Somewhat Agree
MF - Mixed Feelings
SWD - Somewhat Disagree
SD - Strongly Disagree

(continued)

Table H-1
Percentage of Blind Respondents Selecting Each Response Category, by Question and by Age
(continued)

Q.#	Resp.	12-21	22-50	over 50	Q.#	Resp	12-21	22-50	over 50
33.)	SA	0.0	7.1	0.0	37.)	SA	75.0	66.7	75.0
	SWA	25.0	7.1	25.0		SWA	12.5	20.0	0.0
	MF	0.0	0.0	0.0		MF	12.5	13.3	25.0
	SWD	25.0	14.3	0.0		SWD	0.0	0.0	0.0
	SD	50.0	71.4	75.0		SD	0.0	0.0	0.0
Column Total-		30.8	53.8	15.4	Column Total-		29.6	55.6	14.8
34.)	SA	0.0	20.0	0.0	38.)	SA	57.1	16.7	75.0
	SWA	0.0	0.0	0.0		SWA	14.3	33.3	0.0
	MF	0.0	13.3	0.0		MF	14.3	50.0	0.0
	SWD	12.5	13.3	33.3		SWD	14.3	0.0	25.0
	SD	87.5	53.3	66.7		SD	0.0	0.0	0.0
Column Total-		30.8	57.7	11.5	Column Total-		41.2	35.3	23.5
35.)	SA	0.0	7.1	0.0	39.)	SA	100.0	83.3	33.3
	SWA	12.5	14.3	0.0		SWA	0.0	16.7	33.3
	MF	12.5	28.6	0.0		MF	0.0	0.0	0.0
	SWD	25.0	28.6	25.0		SWD	0.0	0.0	33.3
	SD	50.0	21.4	75.0		SD	0.0	0.0	0.0
Column Total-		30.8	53.8	15.4	Column Total-		35.7	42.9	21.4
36.)	SA	0.0	14.3	0.0					
	SWA	0.0	7.1	0.0					
	MF	0.0	14.3	0.0					
	SWD	37.5	21.4	25.0					
	SD	62.5	42.9	75.0					
Column Total-		30.8	53.8	15.4					

SA - Strongly Agree
SWA - Somewhat Agree
MF - Mixed Feelings
SWD - Somewhat Disagree
SD - Strongly Disagree

Table H-2
Percentage of Sighted Respondents Selecting Each Response Category, by Question and by Age

Q. #	Resp.	12-21	22-50	over 50	Q.#	Resp.	12-21	22-50	over 50
1.)	VH	40.0	70.0	22.2	5.)	VH	10.0	30.0	11.1
	SWH	50.0	20.0	22.2		SWH	10.0	20.0	33.3
	HNI	10.0	10.0	55.6		HNI	80.0	40.0	55.6
	SWI	0.0	0.0	0.0		SWI	0.0	10.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	0.0
Column Total-		34.5	34.5	31.0	Column Total-		34.5	34.5	31.0
2.)	VH	60.0	30.0	33.3	6.)	VH	20.0	40.0	11.1
	SWH	40.0	30.0	11.1		SWH	50.0	40.0	44.4
	HNI	0.0	40.0	44.4		HNI	30.0	20.0	44.4
	SWI	0.0	0.0	11.1		SWI	0.0	0.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	0.0
Column Total-		34.5	34.5	31.0	Column Total-		34.5	34.5	31.0
3.)	VH	50.0	50.0	44.4	7.)	VH	10.0	10.0	11.1
	SWH	30.0	30.0	11.1		SWH	20.0	50.0	44.4
	HNI	20.0	20.0	44.4		HNI	70.0	40.0	44.4
	SWI	0.0	0.0	0.0		SWI	0.0	0.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	0.0
Column Total-		34.5	34.5	31.0	Column Total-		34.5	34.5	31.0
4.)	VH	20.0	10.0	22.2	8.)	VH	10.0	0.0	11.1
	SWH	20.0	40.0	44.4		SWH	30.0	50.0	33.3
	HNI	50.0	30.0	33.3		HNI	50.0	50.0	55.6
	SWI	0.0	10.0	0.0		SWI	0.0	0.0	0.0
	SRI	10.0	10.0	0.0		SRI	10.0	0.0	0.0
Column Total-		34.5	34.5	31.0	Column Total-		34.5	34.5	31.0

*VH - Very Helpful
SWH - Somewhat Helpful
HNI - Has No Influence
SWI - Somewhat Impairs
SRI - Seriously Impairs

(continued)

Table H-2
Percentage of Sighted Respondents Selecting Each Response Category, by Question and by Age
(continued)

Q.#	Resp.	12-21	22-50	Over 50	Q.#	Resp	12-21	22-50	Over 50
9.)	VH	10.0	20.0	22.2	13.)	VH	30.0	40.0	33.3
	SWH	10.0	40.0	33.3		SWH	0.0	30.0	33.3
	HNI	80.0	40.0	44.4		HNI	70.0	30.0	33.3
	SWI	0.0	0.0	0.0		SWI	0.0	0.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	0.0
Column Total-		34.5	34.5	31.0	Column Total-		34.5	34.5	31.0
10.)	VH	10.0	0.0	11.1	14.)	VH	10.0	50.0	22.2
	SWH	10.0	30.0	22.2		SWH	30.0	20.0	55.6
	HNI	80.0	50.0	66.7		HNI	60.0	30.0	22.2
	SWI	0.0	20.0	0.0		SWI	0.0	0.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	0.0
Column Total-		34.5	34.5	31.0	Column Total-		34.5	34.5	31.0
11.)	VH	0.0	10.0	33.3	15.)	VH	0.0	10.0	12.5
	SWH	30.0	40.0	22.2		SWH	10.0	10.0	12.5
	HNI	70.0	40.0	44.4		HNI	80.0	60.0	62.5
	SWI	0.0	10.0	0.0		SWI	10.0	20.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	12.5
Column Total-		34.5	34.5	34.5	Column Total-		35.7	35.7	28.6
12.)	VH	20.0	20.0	33.3	16.)	VH	20.0	20.0	0.0
	SWH	60.0	40.0	22.2		SWH	0.0	20.0	0.0
	HNI	20.0	30.0	44.4		HNI	80.0	50.0	85.7
	SWI	0.0	10.0	0.0		SWI	0.0	10.0	14.3
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	0.0
Column Total-		34.5	34.5	31.0	Column Total-		37.0	37.0	25.9

*VH - Very Helpful
SWH - Somewhat Helpful
HNI - Has No Influence
SWI - Somewhat Impairs
SRI - Seriously Impairs

(continued)

Table H-2
Percentage of Sighted Respondents Selecting Each Response Category, by Question and by Age
(continued)

Q.#	Resp.	12-21	22-50	Over 50	Q.#	Resp.	12-21	22-50	Over 50
17.)	VH	20.0	10.0	0.0	21.)	VH	10.0	20.0	0.0
	SWH	0.0	30.0	28.6		SWH	0.0	10.0	0.0
	HNI	80.0	50.0	57.1		HNI	70.0	40.0	66.7
	SWI	0.0	10.0	14.3		SWI	10.0	20.0	22.2
	SRI	0.0	0.0	0.0		SRI	10.0	10.0	11.1
Column Total-		37.0	37.0	25.9	Column Total-		34.5	34.5	31.0
18.)	VH	20.0	10.0	14.3	22.)	VH	0.0	30.0	0.0
	SWH	10.0	20.0	28.6		SWH	20.0	0.0	11.1
	HNI	70.0	60.0	57.1		HNI	80.0	40.0	66.7
	SWI	0.0	10.0	0.0		SWI	0.0	30.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	22.2
Column Total-		37.0	37.0	25.9	Column Total-		34.5	34.5	31.0
19.)	VH	20.0	30.0	12.5	23.)	VH	20.0	10.0	0.0
	SWH	0.0	10.0	12.5		SWH	0.0	0.0	11.1
	HNI	80.0	50.0	62.5		HNI	80.0	50.0	66.7
	SWI	0.0	10.0	12.5		SWI	0.0	30.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	10.0	22.2
Column Total-		35.7	35.7	28.6	Column Total-		34.5	34.5	31.0
20.)	VH	20.0	22.2	0.0	24.)	VH	20.0	60.0	22.2
	SWH	0.0	11.1	0.0		SWH	30.0	10.0	33.3
	HNI	80.0	55.6	87.5		HNI	40.0	30.0	44.4
	SWI	0.0	11.1	12.5		SWI	10.0	0.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	0.0
Column Total-		37.0	33.3	29.6	Column Total-		34.5	34.5	31.0

* VH - Very Helpful
SWH- Somewhat Helpful
HNI- Has No Influence
SWI- Somewhat Impairs
SRI- Serious Impairment

(continued)

Table H-2
Percentage of Sighted Respondents Selecting Each Response Category, by Question and by Age
(continued)

Q.#	Resp	12-21	22-50	Over 50	Q.#	Resp	12-21	22-50	Over 50
25.)	VH	60.0	70.0	25.0	27.)	VH	30.0	40.0	22.2
	SWH	10.0	30.0	75.0		SWH	20.0	10.0	11.1
	HNI	30.0	0.0	0.0		HNI	50.0	50.0	55.6
	SWI	0.0	0.0	0.0		SWI	0.0	0.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	11.1
Column Total-		35.7	35.7	28.6	Column Total-		34.5	34.5	31.0
26.)	VH	60.0	60	25.0	28.)	VH	10.0	60.0	11.1
	SWH	30.0	30.0	50.0		SWH	70.0	40.0	44.4
	HNI	10.0	0.0	25.0		HNI	20.0	0.0	33.3
	SWI	0.0	0.0	0.0		SWI	0.0	0.0	0.0
	SRI	0.0	0.0	0.0		SRI	0.0	0.0	11.1
ColumnTotal-		35.7	35.7	28.6	Column Total-		34.5	34.5	31.0

* VH - Very Helpful
SWH- Somewhat Helpful
HNI- Has No Influence
SWI- Somewhat Impairs
SRI- Serious Impairment

APPENDIX I

REVIEW OF EXISTING AND PROPOSED MODIFICATIONS OF DEVICES AND DESIGNS IN RAIL RAPID TRANSIT WHICH WOULD AFFECT THE TRAVEL OF VISUALLY IMPAIRED PERSONS

Introduction

This appendix is a compilation of all known existing and proposed modifications of devices, systems and procedures which particularly affect the ease and safety of visually impaired persons travelling on rail rapid transit. Its length indicates the magnitude of attention which has been given to facilitating travel by this group of handicapped persons. Perusal of this compilation may stir the imaginations of transit architects, planners and managers, as they attempt to find creative and effective ways of meeting the transit problems of visually impaired travellers.

Inclusion of devices, designs, or procedures (collectively referred to as modifications) in this appendix in no way indicates endorsement by UMTA or by the principal investigators involved in this project. A majority of the modifications included are not based on research but on suggestions made by visually impaired individuals, professionals working with the visually impaired, or by special needs advisory committees.

No attempt is made to give a rationale for any modifications and no recommendations are made herein for any particular solutions. For the particular recommendations of this project staff, see Chapter 6, "Techniques for Improving Communication With Visually Impaired Travellers In Rail Rapid Transit Environments", and for the rationale behind the recommendations, see "Considerations in the Design of Information Systems for Communicating With the Visually Impaired" in Information for Transit Planners, Volume 2 of Improving Communications With the Visually Impaired In Rail Rapid Transit Systems.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

I.c. References

This compilation is based on literature searches, consultation with transit experts, and consultation with orientation and mobility experts. It also contains some suggestions originating with this project staff.

Sources of modifications are listed below. They are cited in the text by means of superscripts. Suggestions originating with these investigators are identified by the superscript "37".

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PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

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15. Kelly, G., Georgia Institute of Technology. Personal communication. February 1981.

16. Metropolitan Atlanta Rapid Transit Authority/Atlanta Regional Commission. Transition plan for implementation of Section 504 accessibility requirements for handicapped persons. Atlanta, Georgia: Metropolitan Atlanta Rapid Transit Authority, June 1980.

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PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

19. Planning Department, Maryland Department of Transportation Mass Administration. Design actions for the disabled and elderly (Interim report). Baltimore, Maryland: Baltimore Region Rapid Transit System, March 1977.

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PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

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37. Selected modifications identified by the authors of this report.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

I.c. Organization of the Report

Modifications will be organized according to the following transit requirements:

A. Station access and egress

B. Station use

C. Vehicle access and egress

D. Vehicle use

E. Systemwide network

F. Concepts for prototype devices

Categories of modifications for each transit requirement are the following:

1. Signage and other print information
2. Graphic information
3. Auditory information
4. Textural information
5. Special equipment designs
6. Architectural design
7. Operating procedures

Literature search and consultation with transit and orientation and mobility experts have uncovered one or more devices, designs, or procedures in nearly every transit situation and in each category of modification. Where no modifications have been found, the heading is retained in the outline for the sake of consistency in numbering; it is followed by the entry "No modifications identified".

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

Categories of modifications

1. Signage and Other Print Information

Travellers who have low vision have difficulty reading signs because they 1) are difficult to locate, 2) are too small to be read or not positioned where low vision persons can get close enough to read them, 3) do not have good contrast between message and background, or 4) are poorly lighted.

Information which is available in small print to normally sighted persons may be made available to visually impaired persons through the use of large type, or braille. (Alternatively, some of this information may be provided in an auditory form which visually impaired persons can easily obtain and use.)

2. Graphic Information

Visually impaired persons are aided by the use of visual and tactile graphic information such as the use of colors in a system, and the availability of maps and diagrams.

Good system graphics can help travellers with low vision obtain information which normally sighted travellers get by reading signs. For example, the use of different colors to designate different lines within a system, and consistent use of these colors on vehicles, in stations, and on maps can help visually impaired travellers remain oriented as they plan trips, enter stations, and make the decisions involved in getting to the correct platform or in transferring from one line to another.

Large print and raised maps and diagrams may be made available to visually impaired travellers. (Alternatively,

some of this information may be provided on the telephone or by tape recordings available to visually impaired travellers.)

3. Auditory Information

Auditory information about a system is normally available to all consumers via telephone. This service is vital to visually impaired persons.

Announcements in stations and on vehicles, considered very helpful for all travellers, are especially important to totally blind travellers. Sighted persons are able to visually confirm such information as the destination of a vehicle arriving in a station or the name of the next stop a vehicle will make by referring to signs on vehicles or maps in vehicles, by recognizing station names, or by recognizing distinctive graphics or architecture in a station. Totally blind and many low vision travellers cannot use this visual information.

Additional auditory cues in the form of sound sources or special announcements may make it easier for visually impaired travellers to remain oriented in transit environments.

4. Textural Information

The provision of specially textured surfaces either as warnings or guides to visually impaired persons is commonly suggested as a substitute for visual information.

The normally sighted person may visually locate a fare collection device from a considerable distance. The blind traveller, on the other hand, could follow a tactile path to the fare collection device.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

The normally sighted person may see the edge of the platform, and avoid it. The blind traveller could be warned of the proximity of the platform edge by a different floor texture, and know not to progress onto the textured area.

5. Special Equipment Designs

Particular functions and hazards in the rail rapid transit environment have led to the proposal of special or modified equipment to facilitate communication with, and safety of, visually impaired travellers. For example, fare card machines, fare barriers, and transit vehicles can be designed for ease of use by visually impaired travellers.

6. Architectural Design

Particular architectural designs can facilitate travel by visually impaired persons. These standards relate to such topics as stairs and station furnishings.

7. Operating Procedures

Sensitivity of transit personnel and of other travellers to the problems and needs of visually impaired travellers, and a willingness to give assistance when needed, may go further and faster than any other single type of modification in enhancing the ease, safety, and pleasantness of rail rapid transit use by visually impaired persons.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

A. Station Access and Egress

A.1. Locating the Station, and Locating the Entrance to the Station

A.1.1. Signage

A large, well-lighted logo, preferably designed with consideration for low vision persons (see E.1. for specific design requirements), should be placed as consistently as possible in relation to each station entrance. The concept of such logos is becoming more common, although not all are equally legible.[36] Consistent placement in relation to entrances is difficult to achieve because of general considerations such as directions of pedestrian approach and angles of clear viewing, which are also important to low vision persons. Placement of a smaller version of the logo directly over each entrance could help resolve this difficulty.[37]

The practice of lighting logos internally is an excellent aid to location at night.[37]

In Germany, a lighted international symbol for stairs is placed over the station entrance. This may be of help to low vision persons in confirming the location of the entrance as well as indicating the presence of stairs immediately inside.[35]

In Paris, standard symbols are used to indicate station entrances.[35]

In Atlanta, "Station entrance elevators are clearly identified with illuminated overhead signs and the international symbol for accessibility".[25]

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

A.1.2. Graphic Information

A.1.2.1. Contrast Marking

Where station entrances consist of small open shelters with stairs in line with pedestrian traffic along a sidewalk, and leading directly down, a warning to visually impaired persons that there are stairs immediately ahead should be provided by means of distinctive color or marking before the top step.[37]

A.1.2.2. Tactile-Visual Map

A tactile-visual map of Boston and Cambridge, produced by the Massachusetts Institute of Technology in association with the Howe Press of Perkins School for the Blind, contains a map of the rail rapid transit system and selected bus lines. The symbol for each rail rapid transit station indicates whether the station is at, above, or below ground level. This enables blind travellers to anticipate the type of entrance for which they will look.[8]

A.1.3. Auditory Information

A.1.3.1. Electronic Guide Chimes

In Japan, electronic guide chimes are installed in front of buildings, above entrances, to enable visually impaired persons to auditorally locate entrances. These totally transistorized units exist in several models, for different uses, but all produce a "ping-pong" sound consisting of alternating signals at 640 Hz and 770 Hz. These chimes sound continuously.[32]

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

A.1.3.2. Auditory Beacon

This would be continuously emitted pulses of a 900 Hz tone at a level 15 dB above ambient noise, available expressly for the purpose of locating the station entrance. See Appendix I, Section F.3. for further details.

A.1.4. Textural Information

A.1.4.1. Blind Location Cues

"Blind location cues" are suggested "to help blind people orient themselves and/or locate building elements such as entrance doors..." These changes in surface textures should differ from tactile warning signals. [14]

A.1.4.2. "Braille Vinyl Tiles"

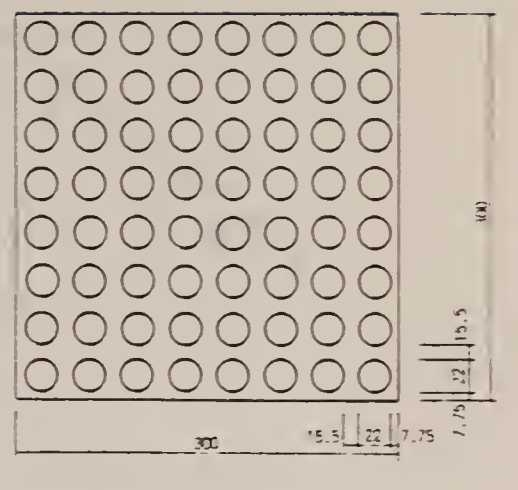
In Japan, "Braille Vinyl Tiles" are recommended for use in front of entrances and exits. These are bright yellow tiles which are glued to existing paving surfaces. [32] See Fig. I-1.

A.1.4.3. "Braille Concrete Blocks"

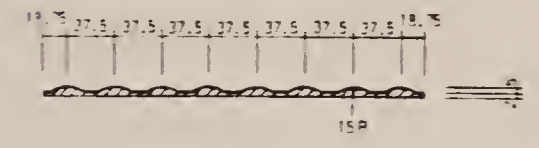
In Japan, "Braille Concrete Blocks" are recommended for use on outdoor walkways and at the entrance and exit areas of stations. These are yellow or green concrete blocks intended to be easily detectable by cane or foot. Some blocks have raised lines and some have circles. Those having lines are used to indicate direction. [32] See Fig. I-2. The "Braille Concrete Blocks", or "Braille Vinyl tiles" may be placed in a long strip to form a tactile path to be followed with the foot or long cane, placed in large sections, or to indicate entrances and exits.

SM300-点D　位置表示用

平面図



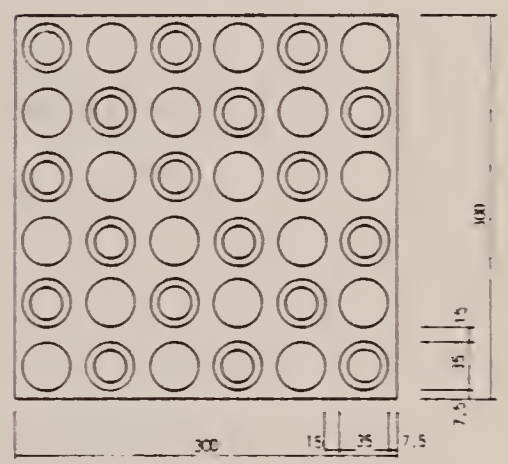
断面図



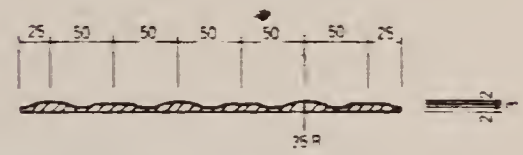
SM300-点E　位置表示用

（触覚効果とノンスリップ効果の兼用タイプ）

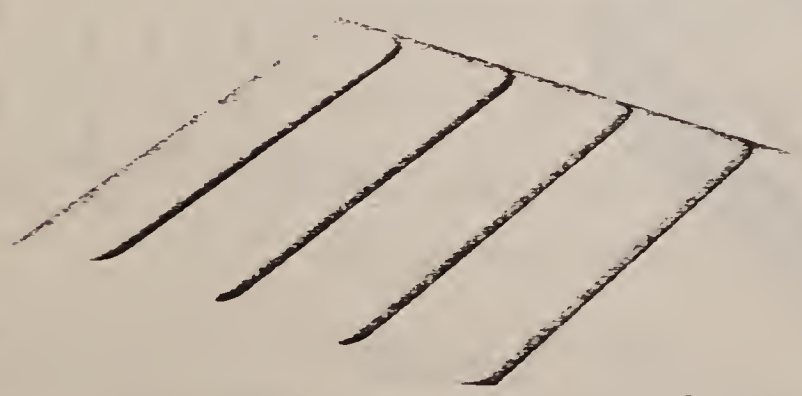
平面図



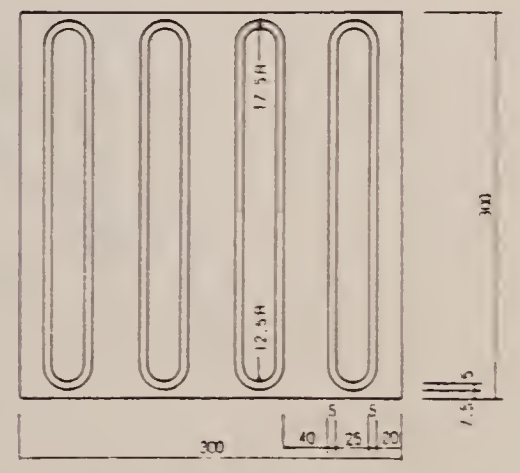
断面図



SM300-線F　誘導表示用



平面図

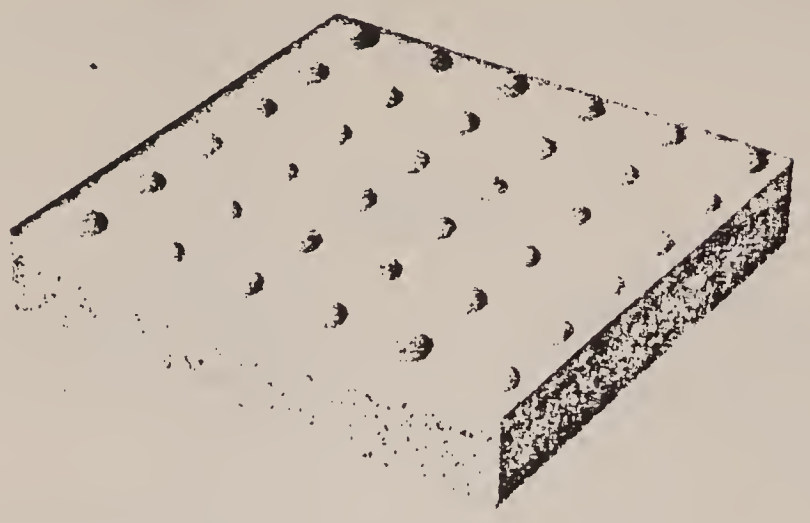


断面図

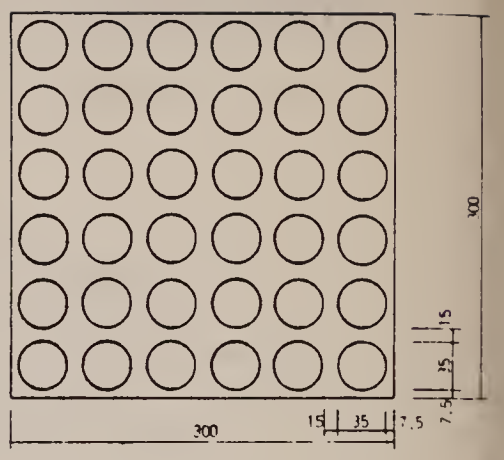
From Traffic Safety Research Center. (Traffic safety apparatus for blind pedestrians.) 26,8,1, Chome, Manpo (or Minamikata) Okayama-City T 700, Japan, 1980.

FIG. I-1. BRAILLE VINYL TILE.

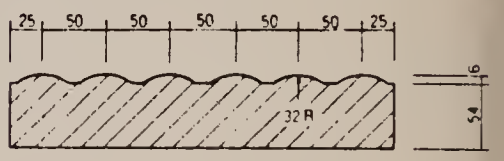
SM300-60-点A　位置表示用



平面図



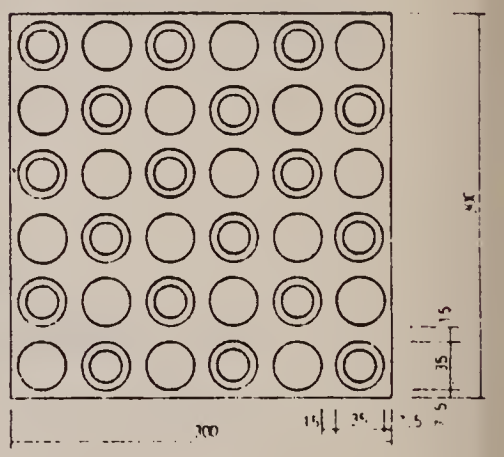
断面図



SM300-60-点B　位置表示用

(触覚効果とノンスリップ効果の兼用タイプ)

平面図



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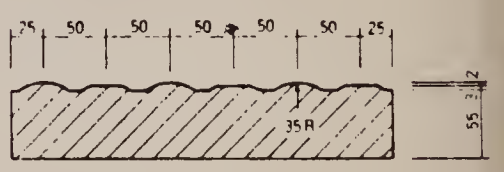
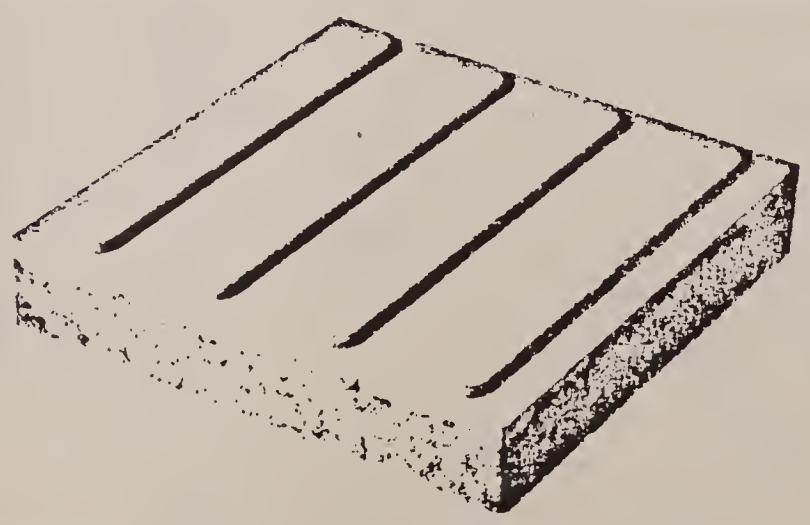
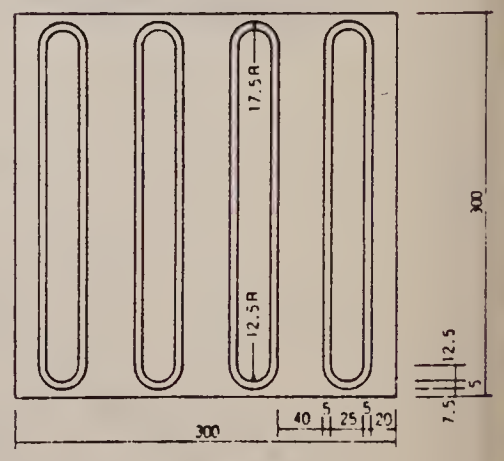


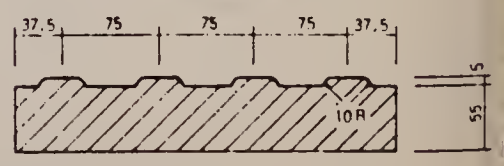
SM300-60-線C　誘導表示用



平面図



断面図



From Traffic Safety Research Center. (Traffic safety apparatus for blind pedestrians.) 26,8,1,Chome, Manpo (or Minamikata) Okayama-City T 700, Japan, 1980.

FIG. I-2. BRAILLE CONCRETE BLOCK.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

A.1.4.4. Tactile Warnings

Where station entrances consist of small open shelters in line with pedestrian traffic along a sidewalk, with stairs leading directly down, a tactile warning should be provided for the safety of blind persons. This may consist of either one step up before the steps down (existing in New York City), or a textured warning strip. New York's step up preceding the steps down was designed primarily to keep water from draining down the stairs, but it alerts blind travellers to the presence of the stairs.

A.1.5. Special Equipment Designs (No modifications identified.)

A.1.6. Architectural Design

A.1.6.1. Consistency

Consistency of design and placement of station entrances helps visually impaired travellers locate these entrances.

A.1.6.2. Maintaining Pedestrian Path Level

In the MARTA system, "...where major pedestrian paths cross vehicular traffic, the pedestrian level has been maintained rather than that of the vehicle, either auto or bus. This provides better pedestrian and wheelchair access than do curb cuts".[25] This should also be safer for visually impaired travellers.

A.1.7. Operating Procedures (No modifications identified.)

A.2. Re-orientation After Exiting the Station

A.2.1. Signage (No modifications identified.)

A.2.2. Graphic Information

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

A.2.2.1. Print Maps

Some systems, Boston and Washington, D.C., for example, now have large display maps near station exits (either inside or outside) which relate the station location to the surrounding area. If designed with consideration for low vision persons, and placed in consistent locations, these maps can greatly assist low vision persons who need additional information to re-orient themselves when exiting a station.[37]

A.2.2.2. Tactile-Visual Maps

A tactile-visual map of Boston and Cambridge produced by the Massachusetts Institute of Technology contains, on registered overlays, a map of the cities and the rail rapid transit system and selected bus routes serving them. This multi-layered map enables totally blind and low vision persons to understand the relationship between the general location of a station and the surrounding streets.[8]

A.2.3. Auditory Information (No modifications identified.)

A.2.4. Textural Information (No modifications identified.)

A.2.5. Special Equipment Designs (No modifications identified.)

A.2.6. Architectural Design (No modifications identified.)

A.2.7. Operating Procedures (No modifications identified.)

A.3. Pedestrian Approaches to Stations

A.3.1. Signage

The interior signage in the MARTA system is color-coded for the main lines. "All entraining signage into a station is the color of the line and all detraining signage leading out of the station is colored white with interior illumination, for clear visibility."[25]

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

A.3.2. Graphic Information (No modifications identified.)

A.3.3. Auditory Information (No modifications identified.)

A.3.4. Textural Information

A.3.4.1. Change in Surface Texture

It is recommended by sources #3, 4, 6, 14, 21, and 32 that a textured surface be used as a "blind location cue" or warning aid. It is suggested for use in the following situations which characterize pedestrian approaches to some stations:

"a. Where vehicular (car or bus) and pedestrian areas abut at a common surface, and no other physical barrier (such as a curb) is provided.

b. Where lines are painted on surfaces to define a pedestrian walk, such as through a parking lot...

c. Where oblique pedestrian crosswalks occur."[14]

The ATBCB standards require a 36-in. (915 mm.) wide and 1/8-in. (3.2 mm.) thick texture strip as a warning in such situations. Another reference recommends further specifications, that "the strip shall be continuous along the hazard, shall be 4 ft. wide and shall be composed of either 1/4 in. maximum size gravel embedded in epoxy cement, or a resilient surfacing material applied to the surface, not thicker than 1/2 in. and textured".[14] These strips "shall have a contrasting color to the walkway surface color".[14]

A.3.4.2. "Safety Studs"

In Japan, "Safety Studs" are recommended to guide blind travellers across open spaces or aid them in staying within

crosswalks. These are currently in use, primarily in areas where there is little snow. They are a silver-aluminum alloy, 15 mm. x 150 mm. x 20 mm. They are said to be easily detectable by cars or pedestrians, but not a hazard to either.[32] See Fig. I-3.

B. Station Use

B.1. Vertical Circulation

B.1.1. Locating Facilities for Changing Levels

B.1.1.1. Signage (No modifications identified.)

B.1.1.2. Graphic Information

Brightly painted approaches to escalators may help visually impaired persons locate them.[21]

B.1.1.3. Auditory Information (See Appendix I, Section F., Prototype Devices - paragraphs F.1. and F.2. for a discussion of "Talking Signs" and "Remote Auditory Indicators".)

B.1.1.4. Textural Information

B.1.1.4.1. Tactile Warnings

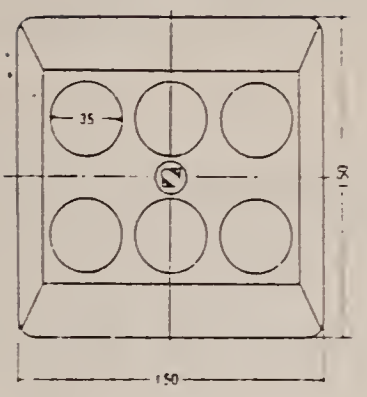
Tactile warnings are suggested at the tops and bottoms of stairs, ramps, and escalators.[3,4,6,14,16,17,32] These vary in the distance from which they extend out from the change of level, from 2 ft. to 3 ft. (610 mm. to 915 mm.). It is usually also recommended that they vary in color from the surrounding floor.

B.1.1.4.2. "Braille Vinyl Tiles"

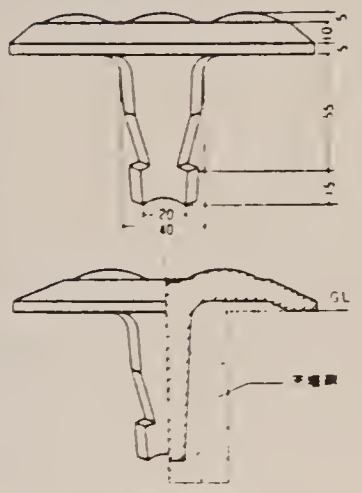
In Japan, "Braille Vinyl Tiles" are recommended to indicate stairs.[32] (See Fig. I-1.)

SM-15-S

平面図

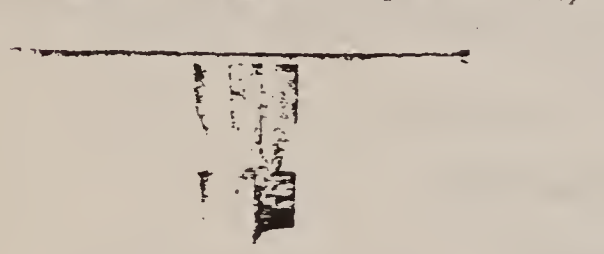


側面図

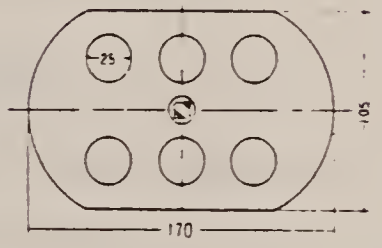


断面図

SM-10-S



平面図



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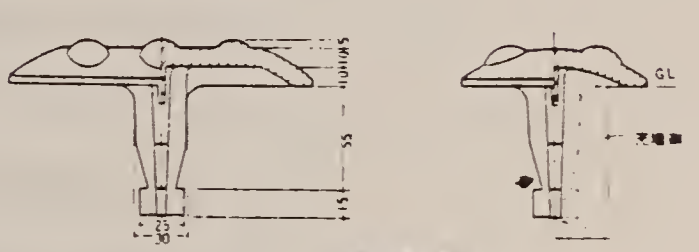
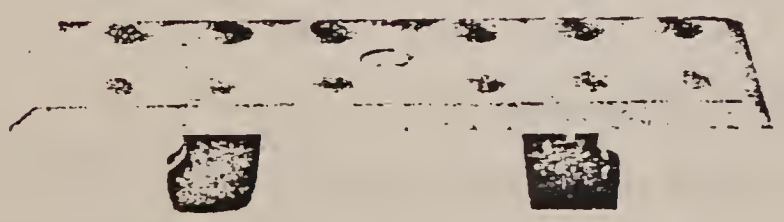
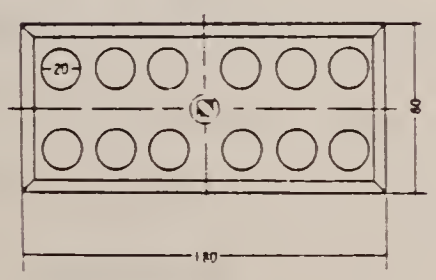


断面図

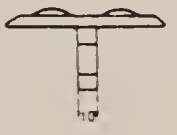
SM-7-S

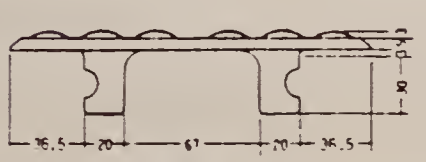


平面図

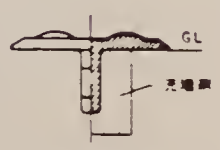


側面図





側面図



断面図

From Traffic Safety Research Center. (Traffic safety apparatus for blind pedestrians.) 26,8,1, Chome, Manpo (or Minimikata) Okayama-City T 700, Japan, 1980.

FIG. I-3. BRAILLE SAFETY STUD.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

B.1.1.4.3. Tactile Warning and Direction Indicators

Tactile warning strips indicating the direction of travel are recommended [17] to precede escalators by a distance sufficient to enable the visually impaired traveller to determine the direction and board the desired escalator. Specifications for these direction indicators are not given.

B.1.1.5. Special Equipment Designs

B.1.1.5.1. Telephone to Call Elevator

In the PATCO stations [35] elevators must be called by using a PATCO telephone near the elevator. This practice requires the visually impaired person to find not only the elevator, but also the phone. Absolutely consistent location of such telephones is recommended by these investigators. [37]

B.1.1.6 Architectural Design

B.1.1.6.1. Handrails

Various guidelines or standards have indicated that handrails should extend beyond the tops of stairs, ramps, or escalators for distances ranging from 1 ft. (305 mm.) to 3 ft. 6 in. (1,065 mm.). [3,4,6,16,21] This may help a totally blind person to locate these facilities.

B.1.1.6.2. Grouping Facilities

Where stations offer escalators, stairs, and elevators together in one area, this helps the visually impaired person to locate the facilities which he can manage

most easily.[23]

B.1.1.6.3. Direction Indicators for Escalators

Lights or lighted arrows are commonly positioned either near the handrail or overhead, to indicate whether a particular escalator is going up or down. These are visible to some low vision persons.[37]

B.1.1.7. Operating Procedures (No modifications identified.)

B.1.2. Changing Level

B.1.2.1. Signage

B.1.2.1.1. Elevator Call Buttons

The (Affiliated) Leadership League of and for the Blind of America (subsequently referred to as ALL), suggests that elevator call buttons be shaped so they point upward and downward.[2]

The Maryland Department of Transportation[19] suggests that call buttons be labelled with raised letters and braille.

B.1.2.1.2. Labels in Elevators

ALL[2] recommends the requirement that raised Arabic numerals with squared shoulders on the surface edge be placed to the left of all floor buttons on elevator panels and suggests that braille numbers be placed to the left of the Arabic numerals. ALL further recommends a raised five-point star to identify the ground, or main, floor, and a raised telephone and bell to identify the emergency call button. It is suggested by other sources[3,14]

that such symbols be raised 1/32 in. (0.8 mm.).

B.1.2.1.3. Labels on Door Jambs

It is recommended that raised standard Arabic numerals be placed on both sides of door jambs to identify each floor in a building.[2,3,4,6,14]

It is suggested that such numerals be placed 5 ft. (1525 mm.) from the floor, and they should be 2 in. (50 mm.) high, raised 1/32 in. (0.8 mm.) and be in a contrasting color.[14]

B.1.2.1.4. Engraved Letters on Elevator Buttons

In the MARTA system, all elevator controls, "...both outside call buttons and inside operating buttons are lowered to be within wheelchair reach".[25] The control buttons are "vandal resistant" and have engraved lettering, presumably as an aid to the blind.

B.1.2.2. Graphic Information

B.1.2.2.1. Edge Markers

Escalators and stairs should have bright-edged markers on the lip of each step.[10,11,17]

B.1.2.2.2. Contrasting Handrails

Handrails should be painted in a color contrasting in intensity and hue from surrounding surfaces.[3]

B.1.2.3. Auditory Information

Audible indicators of car arrival[3,16,19] and car direction[3,14] should be provided and there should be an audible floor indicator.[14,16]

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

B.1.2.4. Textural Information (No modifications identified.)

B.1.2.5. Special Equipment Designs (No modifications identified.)

B.1.2.6. Architectural Design

B.1.2.6.1. Continuous Handrails

Stairs should have continuous handrails.[3,4,6,14] Aiello & Steinfeld[3] caution that handrail extensions "should not be too long - 12 in. (305 mm.) is an appropriate length. Long extensions might protrude into paths of travel and might be aesthetically unpleasing."

B.1.2.6.2. Handrail Height

Standardization of handrail height helps visually impaired persons locate handrails. The ATBCB recommends handrail height between 2 ft. 8 in. and 2 ft. 10 in. (813 mm. to 864 mm.).[6]

B.1.2.7. Operating Procedures (No modifications identified.)

B.2. Fare Payment

B.2.1. Locating Machines (Fare Card and/or Coin or Token Deposits)

B.2.1.1. Signage

A sign following the ATBCB standards (see E.1.1. - E.1.7.) should be located above or near each bank of machines, indicating the function of the machines.[37]

B.2.1.2. Graphic Information

Machines should contrast in intensity (brightness) and hue (color) with their surroundings.[37]

B.2.1.3. Auditory Information

Any of the auditory solutions suggested for locating entrances (see A.1.3.) could be used as an aid in locating machines.[37]

B.2.1.4. Textural Information

Any of the texture solutions suggested for locating entrances

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

(see A.1.4., "Braille Concrete Blocks" and "Braille Vinyl Tiles" could be used as an aid in locating machines.[37]

B.2.1.5. Special Equipment Designs (No modifications identified.)

B.2.1.6. Architectural Design

Consistent placement of machines within a system could aid blind persons in locating these machines.[37]

B.2.1.7. Operating Procedures (No modifications identified.)

B.2.2. Manipulating Machines

B.2.2.1. Signage

PATCO[26] has proposed to modify their ticket vending machines so that all information previously displayed in print or engraved letters will be in raised large type (5/8 in. to 1 in. (16 mm. to 26 mm.) high x 1/32 in. (0.8 mm.) thick), having good contrast with its background. (See Fig. I-4.) The mounting height does not exceed 4 1/2 ft. (1370 mm.). Each fare zone is painted in a contrasting color.

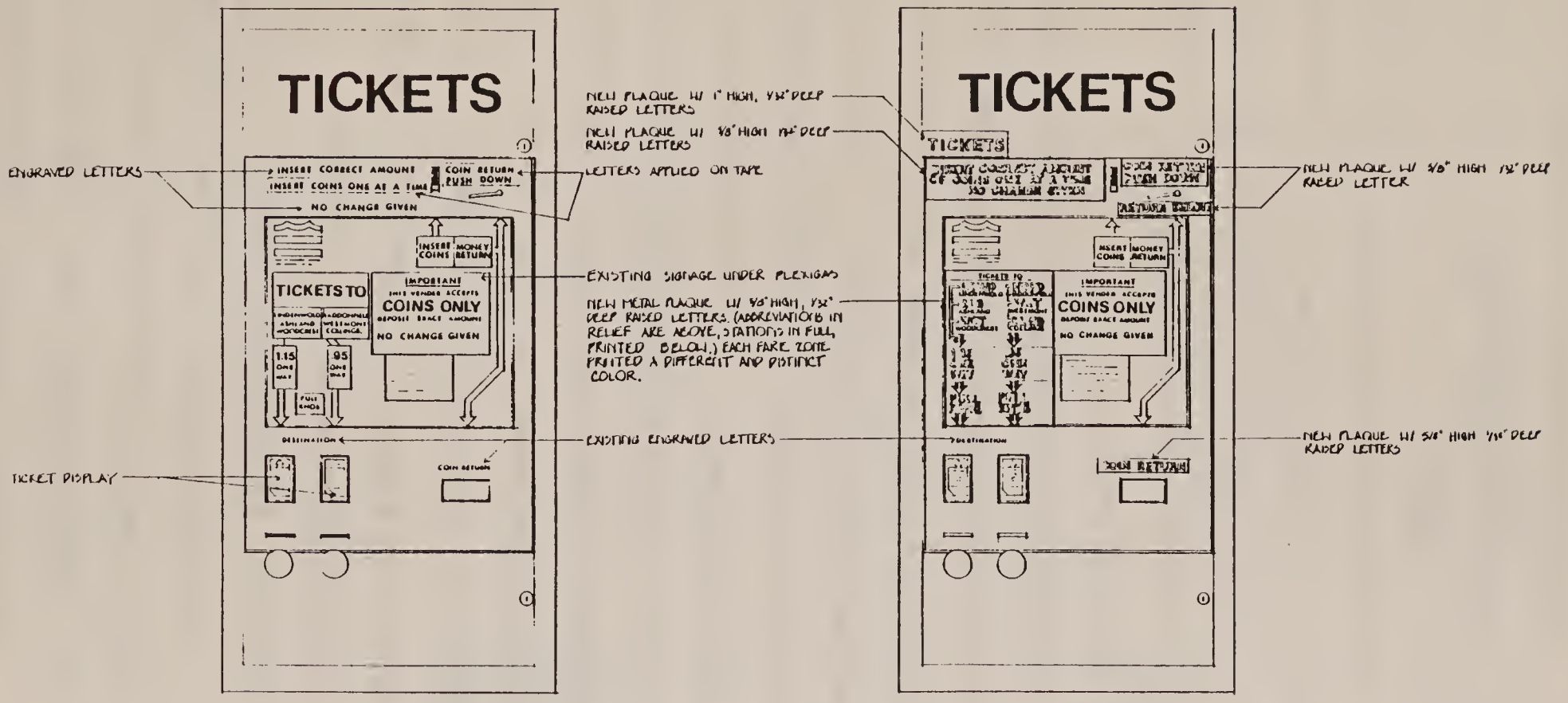
B.2.2.2. Graphic Information

Slots for coins or cards should have borders which contrast with the rest of the machine so the slots can be located easily by low vision travellers.[37]

B.2.2.3. Auditory Information

Where use of a machine requires reading a light-emitting diode (as in the add fare component of the WMATA machines), a spoken read-out should also be provided for visually impaired travellers.[37]

EXHIBIT V-3
POSSIBLE MODIFICATIONS TO TICKET VENDOR INSTRUCTIONS



EXISTING TICKET MACHINE

MODIFIED TICKET MACHINE

FIG. I-4. PROPOSED PATCO TICKET VENDING MACHINES.

From Simpson & Curtin, Ueland & Junker, Weinman, M.R. (Draft) Port Authority Transit Corporation transition plan in compliance with Section 504 of the Rehabilitation Act of 1973. Camden, New Jersey: Delaware River Port Authority, December 1, 1980.

KEY

TICKETS - NEW RAISED LETTERS
COINS ONLY - PRINTED LETTERS

NOTE

ALL RAISED LETTERS ARE ALSO PRINTED ON FOR THE EASE OF READING BY THE NON-VISUALLY HANDICAPPED RAISED LETTERS WILL BE COLOR CODED ACCORDING TO FARE ZONE.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

B.2.2.4. Textural Information (No modifications identified.)

B.2.2.5. Special Equipment Designs

B.2.2.5.1. Slots

Slots for coins or cards should have a raised border so they can be easily located by blind travellers. These borders should be so designed that they guide the coins or cards into correct position.[37] The MARTA slots are so designed.

The MBTA (Massachusetts Bay Transportation Authority) has recently developed a reader for magnetically encoded passes which would be especially easy for a visually impaired person to manipulate. It consists of two parallel, rounded raised bars spaced about 1/8 in. apart, approximately 1 in. diameter by 6 in. long, mounted on top of a conventional turnstile housing. The device is much larger than a conventional slot, and therefore easier to locate by touch. The ends are tapered so that contacting any part of the ends of the device with a card will automatically guide the card into correct position between the two bars.

B.2.2.5.2. Fare Cards or Passes

Fare cards or passes should be so designed that a tactual clue facilitates correct orientation for insertion. PATCO has such a card. (See Fig. I-5.)

The fare card (klippekort) used in Copenhagen

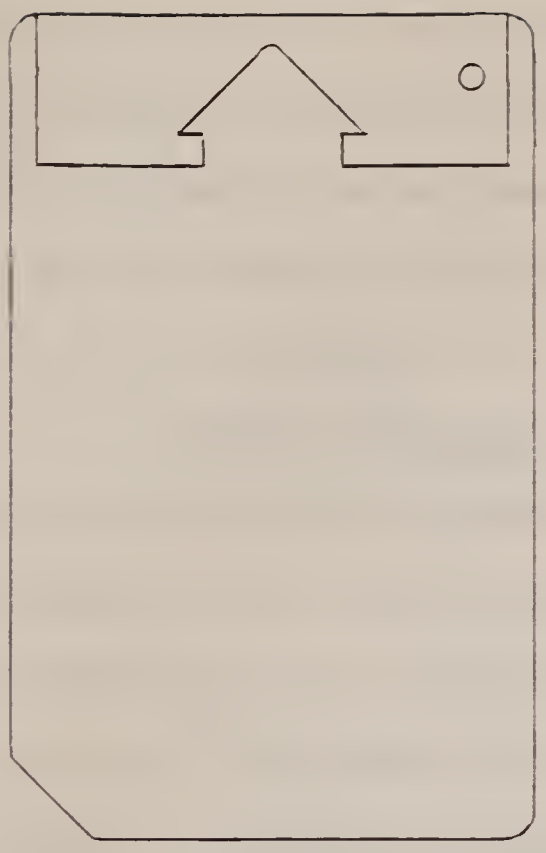


FIG. I-5. FARE CARD, PATCO. THE DIAGONAL CORNER ENABLES TACTILE ORIENTATION.

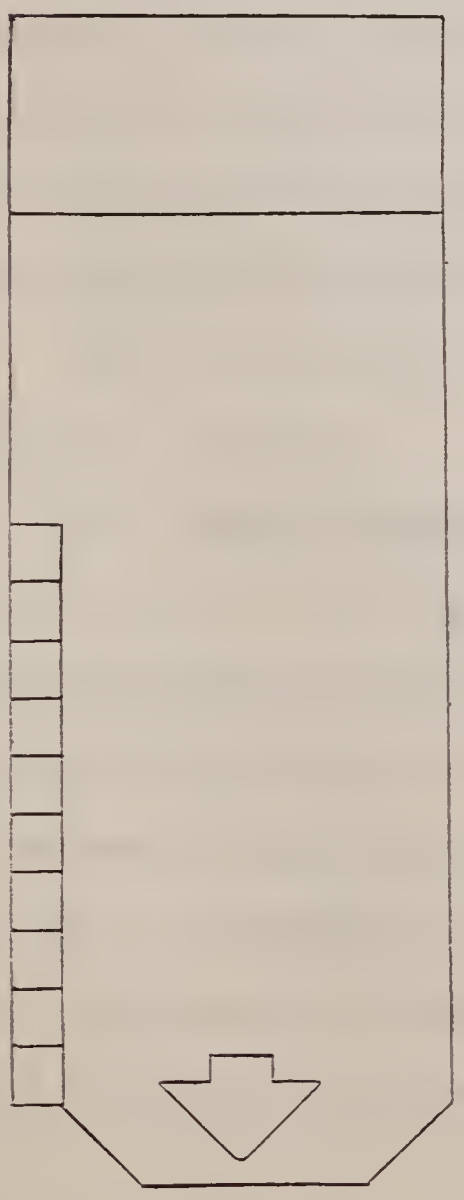


FIG. I-6. FARE CARD, DANSKE STATSBANER. TACTILE ORIENTATION IS MADE POSSIBLE BY THE DIAGONAL CORNERS AND THE CLIPPED SQUARES.

ONE SQUARE IS CLIPPED OFF EACH TIME THE CARD IS INSERTED INTO THE VALIDATING MACHINE.

1981

(De Danske Statsbaner) not only has a tactile orientation clue, but also has a tactile means of indicating the fare value remaining on the card. (See Fig. I-6.) A piece of the card is clipped off by a validating machine each time the card is inserted.

B.2.2.5.3. Closed Fare Gates

The fact that a fare gate is closed may be indicated by a red light, a small sign on the gate, or a large print sign (CLOSED), which is on an arm which obstructs entry into the closed gate.[35]

B.2.2.6. Architectural Design (No modifications identified.)

B.2.2.7. Operating Procedures

Ticket agents, when collecting fares, should use statements such as "here is your change", or say "OK" to indicate to the visually impaired traveller that a turnstile or gate has been unlocked for him. If necessary, the blind person's hand should be guided to his change.[9]

B.3. Platform

B.3.1. Locating Correct Platform

B.3.1.1. Signage

Signs on the platform should follow the ATBCB standards,[37] (see E.1.) and may make use of familiar visual symbols for the benefit of visually impaired travellers.[16]

B.3.1.2. Graphic Information

Where different rail rapid transit lines are color-coded, color-coding in the decor of a platform used by

that line, and in signs directing travellers to that line, may be especially helpful where a station serves more than one line.[37] Where platforms serve more than one line, the colors of each line would be used.

B.3.1.3. Auditory Information

The "Talking Signs" or "Remote Auditory Indicators" (see Appendix I, Section F.) suggested for locating entrances could give specific verbal directions for locating all platforms. The message, in this application, would be located immediately inside the fare barrier.[37]

Upon arrival on a platform, the "Talking Signs" or "Remote Auditory Indicators" could tell those users who triggered the auditory information the destination or destinations of trains using that platform.[37]

In addition, either of these devices could contain intermediate directions where routes to platforms are complex.[37]

B.3.1.4. Textural Information

In Japan, "Braille Resin Plates", thin yellow textured tiles which are applied to cement, are used as a directional signal, along a concourse, at turning points, as well as at the edge of inside platforms.[32] (See Fig. I-7.)

B.3.1.5. Special Equipment Designs (No modifications identified.)

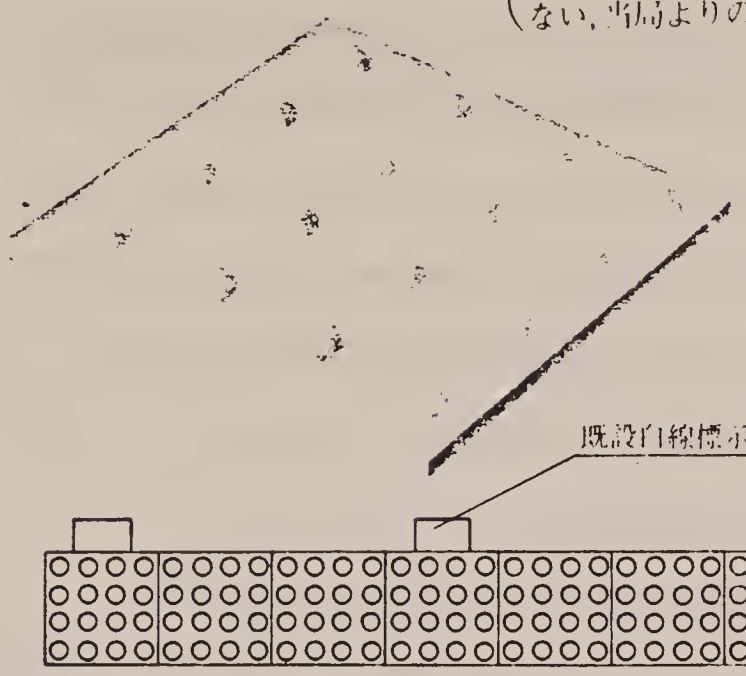
B.3.1.6. Architectural Design

B.3.1.6.1. Station Floor Plans

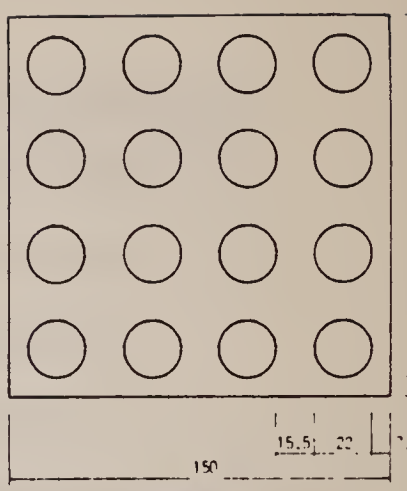
Station floor plans should emphasize simplicity,

SM-150-L-点G　位置表示用

（新幹線岡山↔博多間の開業にともない，当協会よりのご依頼により開発）



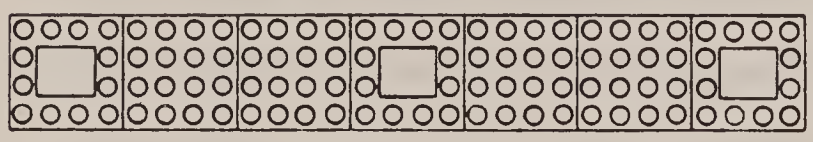
（例示）



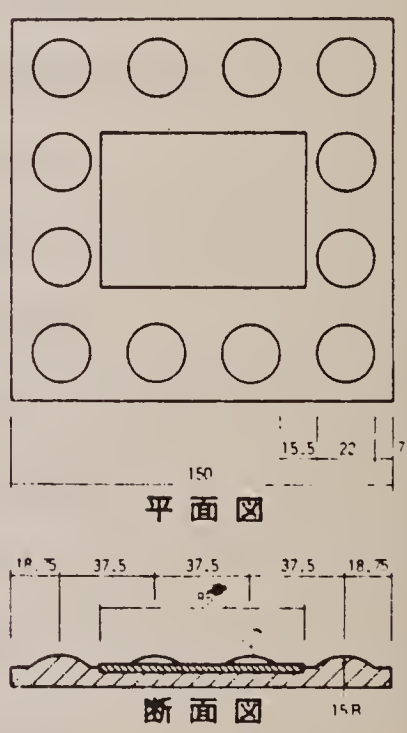
SM-150-L-点H　位置表示用　（白線兼用タイプ）

新規格品（特注品）

（例示）

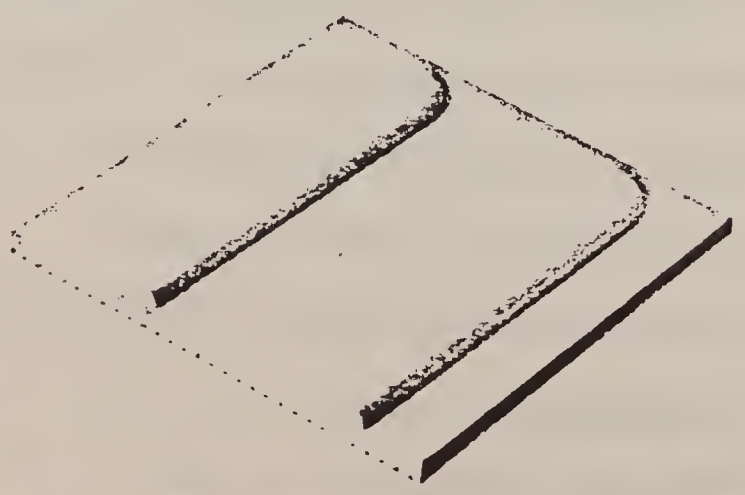


（点Gと点Hを組合せて使用した場合）

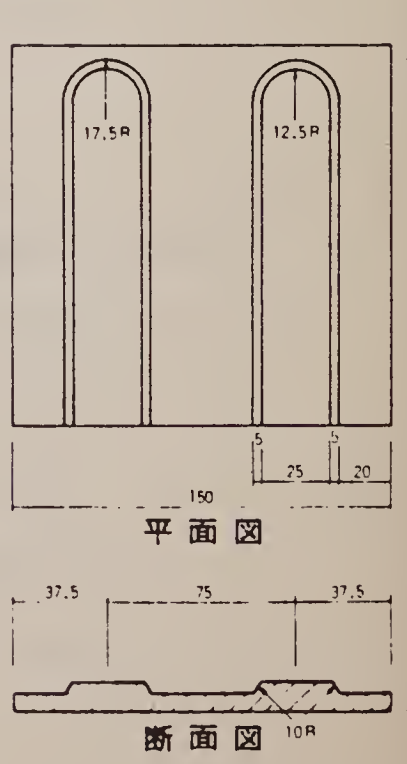


SM-150-L-線I　誘導表示用

新規格品（特注品）



（例示）



From Traffic Safety Research Center. (Traffic safety apparatus for blind pedestrians.) 26,8,1, Chome, Manpo (or Minamikata) Okayama-City T 700, Japan, 1980.

FIG. I-7. BRAILLE RESIN PLAT

consistency, and rectilinear spaces to aid in spatial orientation.[37] (It is difficult for blind people to remain oriented in spaces which are irregular in shape and which are characterized by curved surfaces. It is helpful if station plans are rectangular or consist of modules of connected rectangles.) The general station layout in the MARTA system, with "centralized vertical circulation elements, clear unobstructed circulation paths with orientation edges leading into the station and to the train platform" aid spatial orientation for the visually handicapped.[7]

B.3.1.6.2. Supporting Columns

Supporting columns are ideally rectangular, with long sides parallel to the platform edges or to the main flow of pedestrian traffic. Visually impaired persons can square off or align with any side of such columns to cross an open space, and they can determine or confirm their direction of travel by noting whether they contact a long or short side.[37]

B.3.1.7. Operating Procedures (No modifications identified.)

B.3.2. Arriving at a Safe, Appropriate Waiting Position

B.3.2.1. Locating/Avoiding Platform Edge

B.3.2.1.1. Signage

Signs should follow the ATBCB standards.[37] (Signage is reported in detail in E.1.)

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

B.3.2.1.2. Graphic Information

A very common suggestion and practice is to have a contrasting warning strip along the platform edge or near the platform edge.[7,9,16,17,19,25,26] The strips vary in width, distance from the platform edge, and means of achieving the visual contrast. In many cases the strips also differ in texture from the rest of the platform. (The ATBCB does not recommend methods of achieving visual contrast in warning strips, as texture is emphasized in these standards. See B.3.2.1.4.)

B.3.2.1.3. Auditory Information

Either the "Talking Signs" or "Remote Auditory Indicators" could possibly tell users where they should stop, or when they were approaching the platform edge.[37] (See Appendix I, Section F.)

B.3.2.1.4. Textural Information

A common suggestion, implemented (or partially implemented) in some systems (MARTA, NYCTA, MBTA, SEPTA, WMATA, Toronto Transit Commission, throughout Germany)[35] is to have a textured warning strip along the platform edge or near the platform edge. These strips vary in width, distance from the platform edge, and texture (or means of achieving texture).* The strips are

*John Templer, Georgia Institute of Technology, is currently conducting extensive research on the perception of such textural changes by visually impaired travellers. The results of this research should guide decisions regarding uses, dimensions, and textures of such strips.

also usually visually distinctive and may have lights embedded in them (WMATA). The most elaborate use of such strips is in Japan. "Braille Concrete Blocks" (see A.1.4.3.) are used to edge outside platforms, while "Braille Vinyl Tiles" (see A.1.4.2.) or "Braille Resin Plates" (see B.3.1.4.)[32] are used to edge indoor platforms. These textured warning devices are available in yellow or green as well as "different textural configurations, either to indicate direction or simply a warning."[32]

B.3.2.1.5. Special Equipment Designs (No modifications identified.)

B.3.2.1.6. Architectural Design

B.3.2.1.6.1. Protective Barrier

In order to prevent falls from station platforms, this device would provide a 3-foot high rigid barrier at the platform edge, which would be lowered out of the way when a train was ready for boarding.[33] For discussion, see Appendix I, Section F.5.

B.3.2.1.6.2. Warning Barrier

In order to warn travellers of the platform edge and to assist them across the gap between train and platform, this device would provide a short (approximately 6 in.) barrier at the platform edge, which would collapse in such a way that it bridged the gap between train and platform.[33] For discussion, see Appendix I, Section F.6.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

B.4. Exiting or Transferring

B.4.1. Signage

Signs that are distinctive in color and shape, as well as conforming to the ATBCB standards should be used to identify exit or transfer points.[37]

B.4.4. Textural Information

Special flooring textures may be used to demarcate routes to exits, or areas near exits. (See A.1.4.2., A.1.4.3., A.3.4.1., B.3.1.4.)

B.4.5. Special Equipment Designs (No modifications identified.)

B.4.6. Architectural Design (No modifications identified.)

B.4.7. Operating Procedures (No modifications identified.)

B.5. Negotiation Within Stations (Avoidance of Hazards and Obstacles)

B.5.1. Signage (No modifications identified.)

B.5.2. Graphic Information (No modifications identified.)

B.5.3. Auditory Information

Either the "Talking Signs" or "Remote Auditory Indicator" could advise visually impaired travellers about the existence of possible hazards in a station, when the user is in their proximity (see Appendix I, Section F.).

B.5.4. Textural Information (No modifications identified.)

B.5.5. Special Equipment Designs (No modifications identified.)

B.5.6. Architectural Design

B.5.6.1. Circulation Space (Walks, Halls, Corridors, Passageways, Aisles, etc.)

According to the ATBCB[6], circulation spaces must have

80 in. (2030 mm.) minimum clear headroom. If vertical clearance is reduced to less than 80 in., a barrier or a tactile warning should be provided to warn blind or visually impaired persons.[6]

When open space occurs beneath a stairway, a barrier (such as a fence or low wall) shall be provided to prevent a visually impaired person from contacting the underside of the stairs with his head.[6,14]

B.5.6.2. Gratings

Gratings with elongated openings "shall be so placed that the long dimension is perpendicular to the predominant route of travel."[4,6]

Grating openings should be less than 1/2 in. (13 mm.).[3,6]

Gratings shall be skid-proof, flush with the floor, and have a maximum opening of 3/4 in. (19 mm.) in any direction.[26]

B.5.6.3. Pillars

Pillars can help blind persons remain oriented in stations, especially if they are rectangular and have their long sides parallel to the platform edge or parallel to the main line of travel.[37] Round pillars have little value as aids to orientation.

B.5.6.4. Protruding Objects

The ATBCB Guildeines[6] state that:

"No protruding object shall reduce the clear width of an

accessible route or maneuvering space below the minimum required by 1190.50 (b)(1)."

"Objects less than 2'0" (610 mm) long that are fixed to wall surfaces shall not project into accessible routes more than 4 in. (100 mm.) if mounted with their leading edges between 2 ft. 3 in. and 6 ft. 8 in. (685 mm. and 2030 mm.) (nominal dimension) above finish floor."

"Objects fixed to wall surfaces may project more than 4 in. (100 mm.) if mounted with the lower extreme of their leading edge less than 2 ft. 3 in. (685 mm.) above the finish floor. These objects shall not project into the required minimum clear width."

"Free-standing objects mounted on posts or pylons may overhang 1 ft. 0 in. (305 mm.) maximum from 2 ft. 3 in. to 6 ft. 8 in. (685 mm. to 2030 mm.) above ground or finished floor surface."

Another source [14] suggests that no rigid or hard object shall project into the space above the travel path unless there is a 7 ft. 6 in. clearance. Lower objects which project more than 4 in. must:

"a) continue to the floor; or

b) to within 8 in. of floor; or

c) be located in protected areas which are recessed or enclosed by wing walls. Such a protected area shall have a contrasting floor texture and color.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

d) Doors and door closers do not have to conform to this requirement.

e) Where low ceiling heights prohibit the placing of Emergency Exit signs at 7 ft. 6 in. above the floor level, these signs may be placed at 6 ft. 6 in. from finished floor level to bottom of sign."[14]

B.6. Locating Special Facilities (Restrooms, Telephones, Emergency Exits)

B.6.1. Signage

B.6.1.1. Signs

The ATBCB[6] guidelines indicate that "if audible (emergency) alarms are provided (see B.6.3.1.), then provide, in addition, at least one of the following:

"1) A visual alarm device adjacent to each exit sign which flashes in conjunction with audible alarms.

2) A flashing exit sign.

3) Flash frequency of visual alarms shall not exceed 5 Hz."[4,6]

Emergency doors shall be identified by use of two raised block E's, 2 in. x 2 in. centered on the door at a height of 5 ft.[19]

Raised letters on restrooms should be 2 1/2 in. high (65 mm.).[14]

B.6.2. Graphic Information

One proposed solution for the identification of restrooms involves the placement of distinct, raised geometric shapes on

restroom doors. For example, an equilateral triangle could be used to indicate the men's room. The dimensions of the triangle would either be 12 in. per edge[11] or overall size of approximately 60 cm. high and 60 cm. wide.[10] Similarly, the women's room could be denoted by a circle either 12 in.[11] or 60 cm.[10] in diameter. Both shapes would be raised approximately 1/4 in. (6-7 mm.).

The grey value and color of these panels should be distinctive from one another and from the door. Either the international symbols or words "MEN" and "WOMEN" could be used as well to facilitate identification by the fully sighted.[10,11]

B.6.3. Auditory Information

"Audible alarms shall produce a sound pressure level that exceeds ambient room or space noise by 15 decibels or any maximum noise level of 30 seconds duration by 5 decibels, whichever is greater."[6]

B.6.3.2. Talking Signs

The "Talking Signs" could indicate the presence of special facilities (see Appendix I, Section F.1.).

B.6.4. Textural Information

Special flooring textures may be used to demarcate special facilities.[3,4,14,21,32] (See A.1.4., A.3.4.1., B.3.1.4.)

B.6.5. Special Equipment Designs

Public telephones should have push-button, touchtone dialing, as an aid to the blind.[4,26]

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

B.6.6. Architectural Design

B.6.6.1. Emergency Walkways in Tunnels

In the MARTA system, all emergency walkways in tunnels have wall-mounted handrailings.[7]

B.6.6.2. Consistent Location of Telephones

Consistent location of system telephones, especially in unmanned stations, helps visually impaired persons locate these phones. PATCO has accomplished this by locating such a telephone at the end of each fare barrier, reachable from both inside and outside the fare barrier.[35]

B.6.7. Operating Procedures (No modifications identified.)

C. Vehicle Access and Egress

C.1. Determining that Vehicle Goes to Desired Destination

C.1.1. Signage

Well-designed signs (see E.1.) should indicate the final destination of each train, and should be consistently located at the front and rear of each train and on the side of each vehicle, especially adjacent to the doors, at approximately eye level.[37] For example, the PATCO system has a backlit panel of white on black located "at the center point on car side exterior and interior, and on the front end: Lindenwold Local, Ferry Avenue Local, Lindenwold Special, Etc."[25]

C.1.2. Graphic Information

Color-coding on each vehicle (e.g., the color of the car, or a wide colored band running the length of each car) can

indicate the line that vehicle travels, though not the direction of travel.[37]

C.1.3. Auditory Information

Station announcements preceding the arrival of a train can indicate its destination to all travellers. When a train is waiting in a station for longer than the usual egress/access time, the destination of the train should be announced one minute before the doors will close.[37]

Either the "Talking Signs" or "Remote Auditory Indicator", when activated by the visually impaired traveller, could convey to the visually impaired traveller the destination of an arriving vehicle (Appendix I, Sections F.1. and F.2.).

C.1.4. Textural Information (No modifications identified.)

C.1.5. Special Equipment Designs (No modifications identified.)

C.1.6. Architectural Design (No modifications identified.)

C.1.7. Operating Procedures (No modifications identified.)

C.2. Locating Vehicle Door (For Access or Egress)

C.2.1. Signage (No modifications identified.)

C.2.2. Graphic Information

Color contrast between the outside of a vehicle and its interior aids the low vision person in locating open doors.[37]

Also helpful is a discontinuity in graphic design on the side of a vehicle, either one that occurs because it is made conspicuous by the open door, or because the doorways are distinctive.[37]

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

C.2.3. Auditory Information

C.2.3.1. Sound of the Door Opening

The sound made by a door as it opens is currently the most direct means for the visually impaired person to locate that door. Quieting this sound is disadvantageous to the blind.[37]

C.2.3.2. Chimes to Announce Opening and Closing

Chimes or bells are commonly used on newer equipment to announce the opening and closing of doors. If the sound emitters are located at each door, they may help visually impaired travellers locate the doors.[37]

C.2.3.3. Auditory Beacon

An "Auditory Beacon" at each door, which emits a (interrupted) 900 Hz square wave signal at a predetermined level above ambient noise, would be a guide to an open door from inside or outside the vehicle. This would sound like a "bzzz-bzzz-bzzz" continuing as long as the door is open, but audible only from about 8 ft. away. (See Appendix I, Section F.3.)

C.2.4. Textural Information

A specially textured (and colored) area on the platform, marking where doors will open, can enable blind travellers to wait near the door, so they can easily locate it when the train arrives.[32] This is especially pratical on systems with automated stopping, or where time is sacrificed to permit precise manual stopping, as is the case where this system is used in Japan. (See Fig. I-8.)

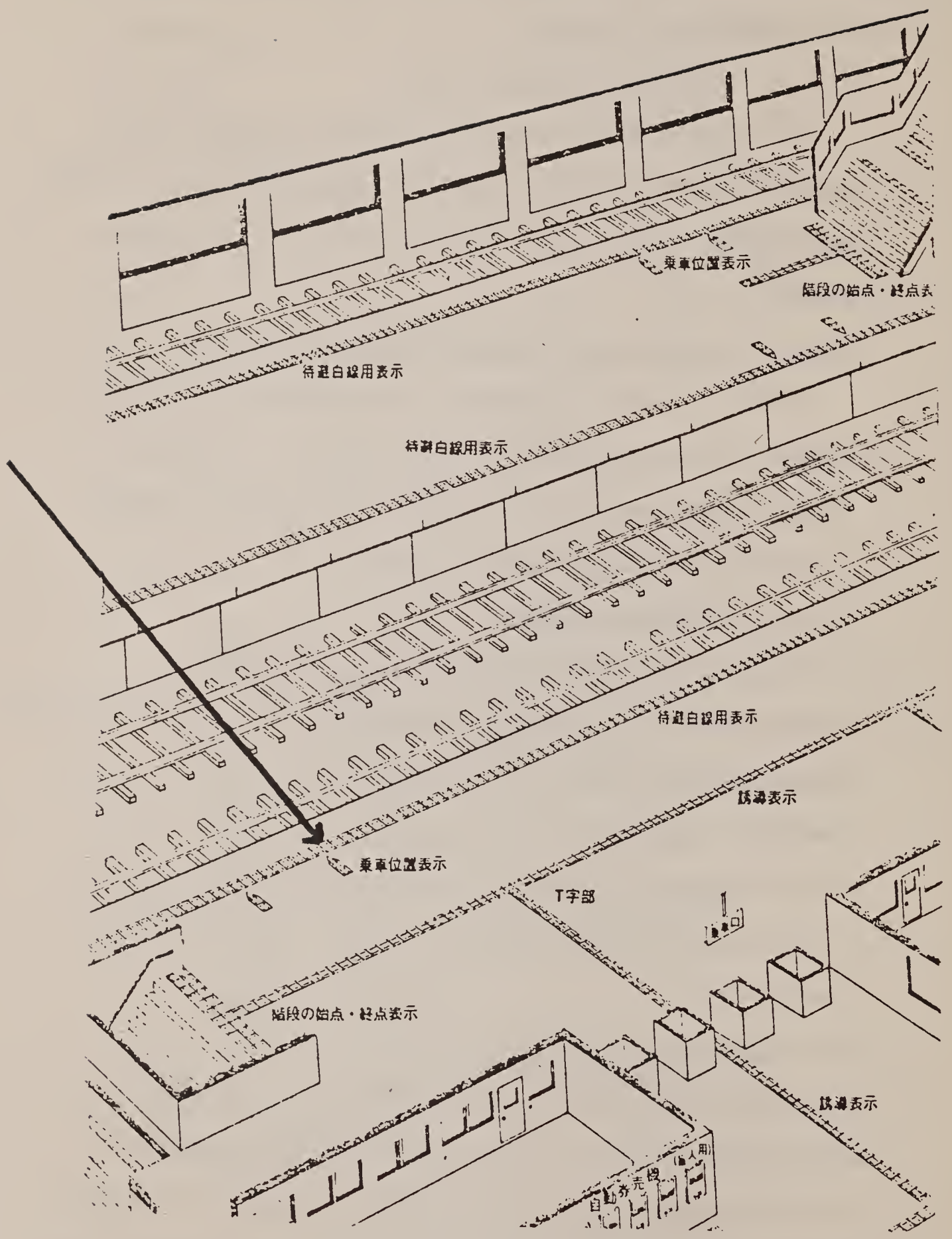


FIG. I-8. USE OF BRAILLE TILES IN SUBWAY STATION TO SHOW WAITING AREAS (WHERE VEHICLE DOORS WILL OPEN).

From Traffic Safety Research Center. (Traffic safety apparatus for blind pedestrians.) 26,8,1, Chome, Manpo (or Minamikata) Okayama-City T 700, Japan, 1980.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

C.2.5. Special Equipment Designs

C.2.5.1. Barrier to Coupling Area

A barrier should be provided between cars so that a blind person cannot mistake the coupling area for an open vehicle door.[37]

C.2.5.2. Vehicle Doors

Vehicle doors should be wide and unobstructed by poles in the middle.[37]

C.2.6. Architectural Design (No modifications identified.)

C.2.7. Operating Procedures

When the train operator notices a blind person having difficulty finding the door, he can manipulate the door open/close button, causing the door-close bell to ring twice.[26]

C.3. Negotiating Platform-Vehicle Gap

C.3.1. Signage (No modifications identified.)

C.3.2. Graphic Information (No modifications identified.)

C.3.3. Auditory Information (No modifications identified.)

C.3.4. Textural Information (No modifications identified.)

C.3.5. Special Equipment Designs

The "Warning Barrier" discussed under B.3. and in Appendix I, Section F. would bridge the gap between platform and vehicle when the vehicle is at the platform.

An extension from the vehicle door has been proposed to reduce the horizontal vehicle-platform gap to within 2 1/2 in.

(65 mm.). "Because the 2 1/2 in. gap will be too narrow to prevent the threshold extension from sideswiping the platform due to car sway, the extension will be a wearing surface designed to be replaceable and of a material that can wear without generating excessive frictional heat. Preliminary investigation suggests that nylon or bakelite may be suitable for the threshold extension, provided a strip of this material is also applied along the platform outer surface where contact is expected."[26]

C.3.6. Architectural Design

Enforcement of restrictions on both vertical and horizontal gap dimensions, motivated chiefly by concern for wheelchair users, would also lessen the insecurity and possible danger to blind transit users. The dimensions of these recommended restrictions vary from 1 1/2 in. (39 mm.)[17,21,26] to 3 in. (78 mm.)[19] for the horizontal gap and from 1 1/2 in. (39 mm.)[21,26] to 2 in. (52 mm.) for the vertical gap.

It is further suggested that "discontinuity of level between stationary platform floor and vehicle interior floor greater than one inch should be clearly marked by contrasting color, changes in floor texture or resiliency and/or lighting."[1]

C.3.7. Operating Procedures (No modifications identified.)

D. Vehicle Use (Riding Safely, Anticipating Stops)

D.1. Signage

Well-illuminated signs at frequent and consistent locations on the platform can inform many low vision persons which station they are entering. Where tinted glass is used in vehicle windows,

additional lighting is necessary for signs to be viewed from within vehicles.[37]

D.2. Graphic Information

D.2.1. Color or Contrast

Use of highly visible colors for handrails and for seats can help low vision persons locate these furnishings.[37]

Distinctive colors or graphic displays in stations help low vision persons recognize them.[23]

D.2.2. Maps

Consistent placement of maps in large type in each vehicle can help some low vision travellers anticipate their stops.[23]

D.3. Auditory Information

D.3.1. In-Car Announcement of Stops

Announcement of up-coming stops, by train operators or by a recording, helps visually impaired persons anticipate arrival at the stop they desire.[37]

D.3.2. Audible Warning of Stops

An audible signal that a stop will occur helps visually impaired persons prepare for braking. It is suggested that such a signal be given no less than 20 seconds before braking.

D.4. Textural Information (No modifications identified.)

D.5. Special Equipment Designs (No modifications identified.)

D.6. Architectural Designs

If handrails are abundant and consistent in placement, visually impaired persons will be able to locate them.[37]

It is suggested that handgrips be placed immediately inside the vehicle door. "If horizontal, they shall have the principal

gripping surface at not less than 30 in. and not more than 60 in. above the floor; if vertical, they shall have a gripping surface extending through at least two-thirds of this height." Handgrips along the full length of seat backs are also suggested.

It has been recommended by the Task Force II of the MBTA Transition Plan "that a method be utilized to cover all handrails on new vehicles with a finish/substance that would provide easier and firmer control as one gripped it."[17]

D.7. Operating Procedures

D.7.1. Priority Seating

Priority seating should be consistent in location throughout vehicles and systems.[37]

D.7.2. Controlled Acceleration and Deceleration

"Maximum starting or braking accelerations should not exceed .1 g. Maximum acceptable jerk (increase in rate of acceleration) shall be not more than 1.5 miles/hr./sec." An audible means of warning passengers that acceleration is about to begin should be incorporated for stops exceeding 20 seconds in duration.

E. Systemwide Network

E.1. Signage

The MBTA Advisory Committee on the Visually Handicapped recommends that signage exist in accordance with ANSI standards for signage.[17]

E.1.1. Character Proportions and Sizes

The ATBCB specifications for signs include the character proportions of width to height ratio between 3:5 and 1:1 and a

stroke width to height ratio between 1:5 and 1:10.[6] These specifications were recommended by some other groups involved with handicapped accessibility.[21,30] The Capitol Development Board of Illinois issued similar requirements, differing only by suggesting width ratio between 1:6 and 1:10.[14]

The National Association of the Visually Handicapped recommends that signs have a minimum apparent size equivalent to 18 pt. type held at comfortable reading distance.[24]

E.1.2. Type

Type faces in sans serif or modified serif styles are considered most readable for low vision individuals.[24,28,30] Helvetica medium is one recommended type.[24]

E.1.3. Raised or Indented Characters or Symbols

Some information signs may have characters which are raised or incised. The ATBCB states that they shall be raised or incised 1/32 in. (0.8 mm.) minimum and shall be sans serif characters. Their height shall be between 5/8 in. (16 mm.) and 2 in. (50 mm.). Indented characters or symbols shall have a stroke width of at least 1/4 in. (6 mm.). Symbols or pictographs on signs shall be raised or indented 1/32 in. (0.8 mm.) minimum and edges shall be sharply defined.[6] (See Fig. I-10.)

E.1.4. Abbreviations

Abbreviations or symbols facilitate the communication of longer messages in a shorter space, and may be better perceived by low vision persons because the eye does not need to fixate so many times to take in the whole message.[37]

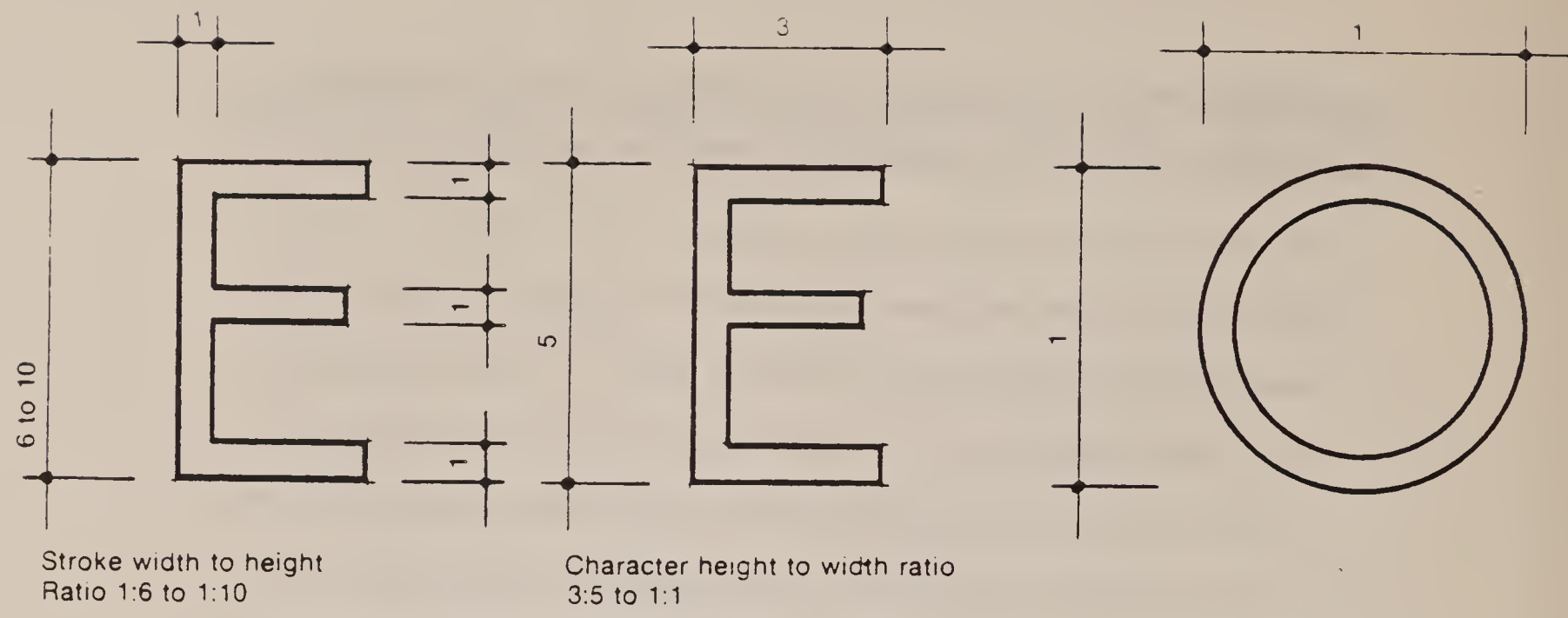


FIG. I-9. REQUIREMENTS FOR CHARACTERS ON SIGNAGE.

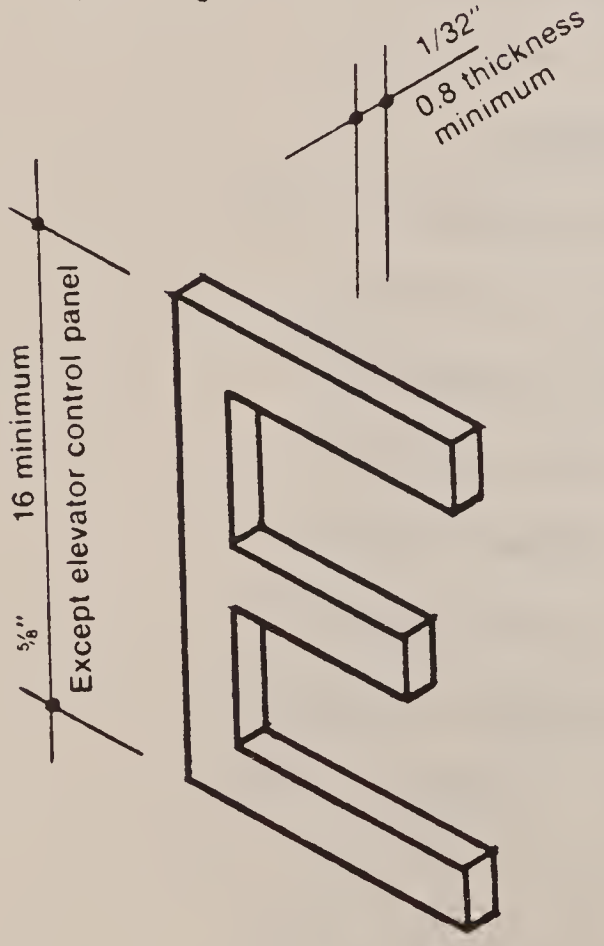


FIG. I-10. REQUIREMENTS FOR RAISED CHARACTERS.

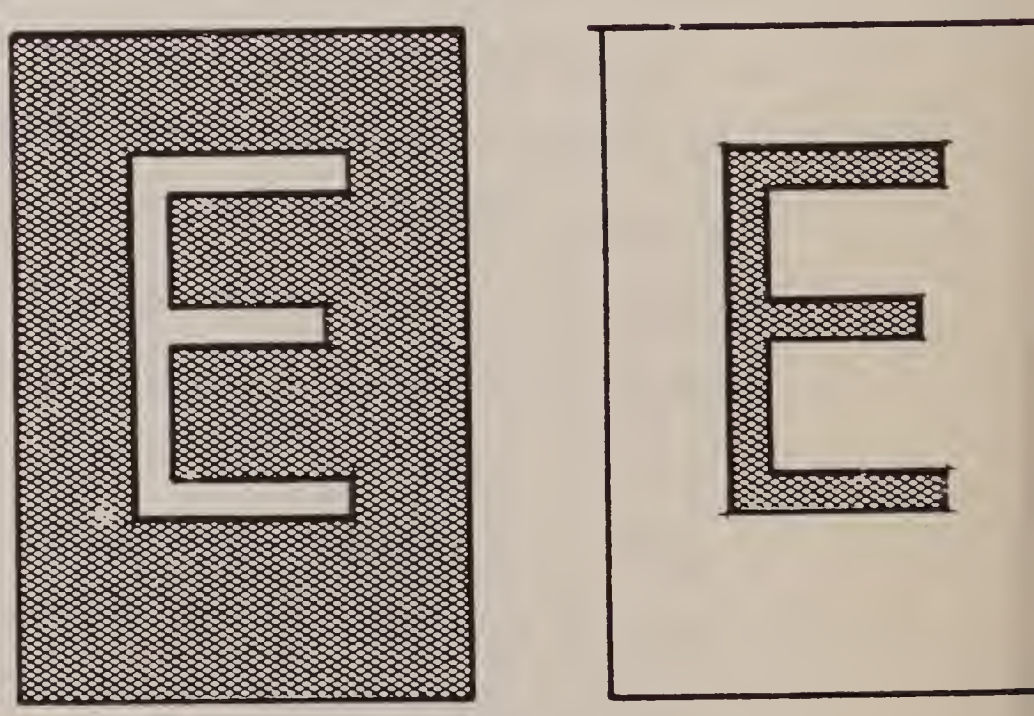


FIG. I-11. CHARACTER SHALL CONTRAST WITH BACKGROUND.

From Jones, M.A. Accessibility standards illustrated. State of Illinois: Capitol Development Board, 1978.

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

E.1.5. Contrast

The ATBCB states that sign characters shall contrast in value with the background - preferably light letters on a dark background.[6] Similar recommendations have been incorporated into 504 transition plans and other accessibility documents.[14,21,26,30]

(See Fig. I-11.)

Where contrast is to be achieved by the use of different colors, it is vital that the colors differ considerably in brightness as well as in hue.[37]

E.1.6. Surface Characteristics

The ATBCB states that sign characters shall be of a matte finish on a matte finish background.[6] Other documents concerned with signage also mention the necessity of glare-free materials in sign construction.[14,21]

E.1.7. Placement

The ATBCB has established recommendations for location and height of signs. Sign location shall be standardized throughout a building or facility.[6]

According to the ATBCB, signs indicating room number and related information shall be located on the latch side of the door at a height between 4 ft. 6 in. (1,370 mm.) minimum to 5 ft. 6 in. (1,675 mm.) maximum as measured from the finish floor to the centerline of the uppermost row of characters.[6]

Although other documents do not specify the location of signs, they do maintain minimum vertical clearance, which affects signs not mounted on a wall.[3,33]

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

E.1.8. Aids to Finding Signs

Distinctive visible designs should be used above head level to call attention to the location of major information centers, such as system or route maps, and schedules.[37]

Throughout German transit stations, a large, internally illuminated "I" is located near each information center, hung about 3 m. above the floor, and oriented perpendicular to the main line of pedestrian flow.[35]

Distinctive overhead lighting fixtures should be positioned near major information sources.[37]

Any of the texture solutions suggested for locating entrances (see A.1.4.) could be used as an aid in locating information signs.[37]

E.1.9. Schedule Information

Schedule information should be available in large type and braille, both within stations and as distributed matter.[14,17] If the volume of such material would be prohibitively large, if produced in braille and large print, then the information should be available through a reliable telephone information service and direct contact with transit personnel.[17]

E.2. Graphic Information

E.2.1. Display Maps

E.2.1.1. Print Maps

Printed display maps designed for all transit users should be designed, produced, mounted and illuminated so that a majority of low vision persons can obtain information

from them.[37]

The Toronto Transportation Commission has produced a small display system map, in bright colors and white, on a black background, which is well-designed for fully sighted and low vision readers. These maps are consistently placed in rail rapid transit vehicles.[23]

Toronto also has large display maps located consistently in each station. These are in large print and well-illuminated, and have bright, contrasting colors. In some cases, a system information telephone is placed beside the map.[23]

Paris has long had display maps which light up a particular route when a destination button is pressed. This system enhances brightness for the lighted route, thereby enhancing legibility for some low vision persons.[35]

E.2.1.2. Tactile Maps

Tactile display maps could be provided in transit stations, mounted beside print maps. The PATCO Draft 504 Transition Plan calls for installation of a relief map of the PATCO system to be located in the stations' unpaid areas. The map and its symbols and labels will be in relief, and the map will be printed in contrasting colors. The cost estimate for one map per station is $750 per station.[26]

E.2.2. Distributed Maps

E.2.2.1. Print Maps

System and route maps should be produced in large type, and be available for distribution to low vision persons.[37]

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

If display system maps are well designed for reading by low vision persons, these same graphics can be used to print maps on matte-finish paper for distribution to low vision persons and to agencies, clinics, and persons who teach low vision persons to travel and to read using their residual vision.[37]

E.2.2.2. Tactile Maps

Tactile system and route maps can be produced for distribution to blind transit users.[37]

Tactile or tactile-visual maps of rail rapid transit systems in the following cities are known to have been produced in quantity, for distribution: Boston; London; Copenhagen; Nuremberg.

E.2.3. Use of Color as an Information Code in Stations and Vehicles

Various lines within each system should be color-coded in colors that are consistently and conspicuously used on vehicles, in stations, and on maps.[37]

E.2.4. Identification of Glass Doors

Glass doors must be clearly defined.[17] Task Force II of the MBTA recommends that decals of contrasting color be placed at face and chest height on all large areas of glass.[17]

E.3. Auditory Information

E.3.1. Telephone Information

Telephone information regarding routes and schedules is especially important to visually impaired persons. Normally available information may not be detailed enough, however,

to enable a visually impaired person to plan all the details of a trip using rail rapid transit. Each telephone information department should have some means of providing the detailed information blind travellers may request. This could be provided by one specially trained person per shift, accessed through an extensive directory to all telephone information personnel through computer stored information, or available through an agency for the visually handicapped.[37]

E.3.2. Telephone Number T-R-A-N-S-I-T

It has been proposed that the telephone "number" T-R-A-N-S-I-T be adopted nationally as the number for all transit information. This would be helpful to visually impaired persons who cannot read telephone books.[35]

E.3.3. Telephones Beside Display Maps

Toronto has system information telephones placed beside display maps in some stations. This practice aids the visually impaired person who is not able to fully utilize the display maps.[23]

E.4. Textural Information (No modifications identified.)

E.5. Special Equipment Designs (No modifications identified.)

E.6. Architectural Design (No modifications identified.)

E.7. Operating Procedures (No modifications identified.)

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

F. Concepts and Prototype Devices

Section F. of this report should be regarded as an introduction to certain prototype devices and systems which are not currently in use (on other than an experimental basis) in any public environment, but which hold some promise as solutions to problems in the use of rail rapid transit by the visualy impaired. As in the preceding section, no endorsement by the authors is expressed or implied by the inclusion of a description of a system or device in this section.

F.1. Talking Signs

The Talking Sign concept and prototype devices were recently developed at Smith-Kettlewell Institute of Visual Sciences in San Francisco. Basically, the device consists of 1) a miniature, low-power infrared light transmitter, the invisible beam from which is modulated with a spoken message which is stored on a tiny computer memory chip, and 2) a receiver which translates the infrared beam into an auditory message. The transmitter is small enough (approximately 2 in. x 2 in. x 1 in.) so that it can be easily placed at the normal location of a visual sign, and the receiver is sufficiently compact and lightweight (2 in. x 3 in. x 1 in.; 6 oz.) so that it is easily carried in the user's pocket when not in use. (See Fig. I-12.) If a sufficient number of signs were placed along routes potentially used by travellers, the Talking Signs would effectively become a verbal pathway which could guide a traveller through a rail rapid transit sytem.

The cost of a Talking Signs System is currently very low. The prototype receivers which would be carried by the users cost

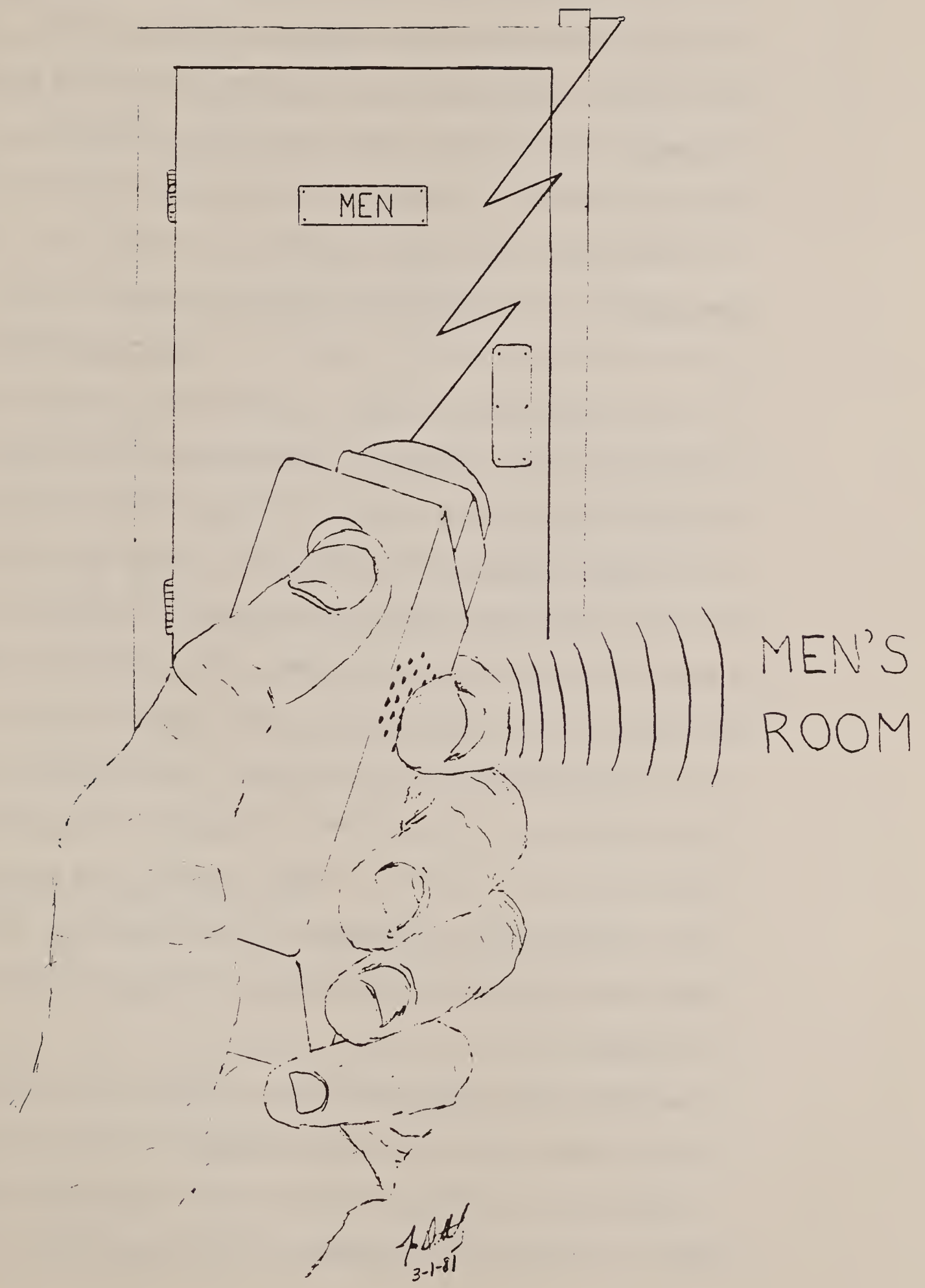


FIG. I-12. ARTIST'S DEPICTION OF A TALKING SIGN BEING USED IN A PUBLIC ENVIRONMENT.

approximately $70.00 each, but it can probably be assumed that each user would purchase this component of this system. (Funds for visually impaired persons to purchase specialized equipment are available through various public and private resources.) The prototype transmitter message chips have been estimated to cost only $5.00 each if purchased in sufficient quantities. The power drawn by the transmitter is negligible and the cost of the prototype transmitter housing and infra-red component is also very low (approximately $25.00). Installation and maintenance would probably be simple, Assuming, then, that a transit system were to outfit 50 rail rapid stations with an average of 30 Talking Sign transmitters each, the total transit-borne cost for the Smith-Kettlewell prototype system would be about $45,000.00 plus installation, maintenance, and power. The prototype transmitter utilizes a 1/2 watt power supply, but a new model which is currently in the design stage will utilize power in the microwatt range, thereby enabling it to be battery-operated for long (2-5 year lithium batteries) periods of time. Assuming such a power supply, costs for installation (adhesion of the Talking Sign to an appropriate surface) and maintenance (change of battery) should be minimal.

Currently, the Talking Signs are in daily use in the Smith-Kettlewell Institute, and it has been reported that they are highly reliable and of great assistance to visually impaired persons there. It must be noted, however, that the existing prototypes

have not yet been field-tested in transit environment. Visual inspection and preliminary testing of the units by this project staff indicate that the packaging would require minor modification if the units were to be operated in extreme climate and weather situations. Also, the number and placement of transmitters would have to be carefully evaluated, since human performance factors, such as hearing and spatial orientation, will necessarily affect these requirements.

Among other factors which would need to be evaluated before specific costs and requirements for a Talking Signs System could be established would be reliability of the system over an extended time period, what sources of electronic interference might be present in a transit environment, whether alternatives to infra-red as the carrier signal (e.g. RF) would be more advantageous in a transit environment, and the reliability of various power supplies, such as batteries or solar cells under climatic variations present in transit stations.

F.2. Remote Auditory Indicators

The major difference between remote auditory indicators and the "Talking Signs" of Section F.1. is the location of the sound source. The "Talking Sign" is actually an electronic transmitter which transmits signals that are converted to auditory information which is broadcast from the location of the user's hand (when the speaker is built into the device) or from the location of the user's ear (if an earphone is used). While there

are probably financial and other advantages to such a system, the system may be of limited value as an auditory beacon. (The read will be able to better appreciate the problem if one envisions oneself in a dark room holding a tape player in hand which is saying "This way to exit".) The remote indicators discussed here would, when remotely triggered, broadcast auditory messages publicly from speakers located at the source of the message, which makes them usable as landmarks as well as information sources.

One method for implementing such a system would be a modification of certain Talking Signs into auditory broadcast units. That is, selected Talking Signs could have receiver/loudspeakers attached to them, so that when activated they would also serve as specific reference points. Examples of messages which would be of greater value if encoded in this way are "This way to trains", "Do not proceed beyond this point", and "Wait here for trains".

The cost of implementing the Modified Talking Signs system would be relatively inexpensive, as the only additions to the Talking Signs system would be a small number of additional receivers and their power sources. The packaging of these receiver/speakers for outdoor use would of course be different, but this should introduce only a minor additional expense per unit when units are purchased in quantities greater than 100 (estimate: $5.00 per unit).

An alternative to the Modified Talking Signs would be a system which exclusively used speakers located at specific points along a pathway (hereafter called Remote Speaker System). These speakers would be activated individually by the presence of an individual

carrying an electronic activator within a pre-determined radius (e.g., 7 ft.). Fig. I-13 depicts the layout of such a system. As can be seen in Fig. I-13 the system would use a pre-determined path to guide the user from a station entrance to the platform or from the platform to the station exit. The advantage of such a system would be its ability to successfully guide a user who was unfamiliar with the system or unable to accurately scan for a sign, or who was unfamiliar with the general layout of the system and who didn't know where to look for signs.

In either the Remote Speaker System or in the Talking Signs System, the total number of units necessary in a given station would significantly affect the cost of the system as a whole. However, since the hardware installed and maintained by the transit system would be a larger percentage of the Remote Speaker System (i.e., the message chip and the speaker system) the cost of hardware and installation can be assumed to be approximately 75% greater than in the Talking Signs System. The cost of maintaining the transit system's components would also be significantly greater.

F.3. Auditory Beacon

Torben Poulsen of the Acoustics Laboratory at the Danish Technical University[22] has done considerable research in Denmark on the advantages of square wave auditory beacons or pathways for use at traffic-light-controlled intersections. He and his co-workers have found that: 1) if the signal/noise ratio is better than 10-15 dB (at the sound source), background noise has no influence on

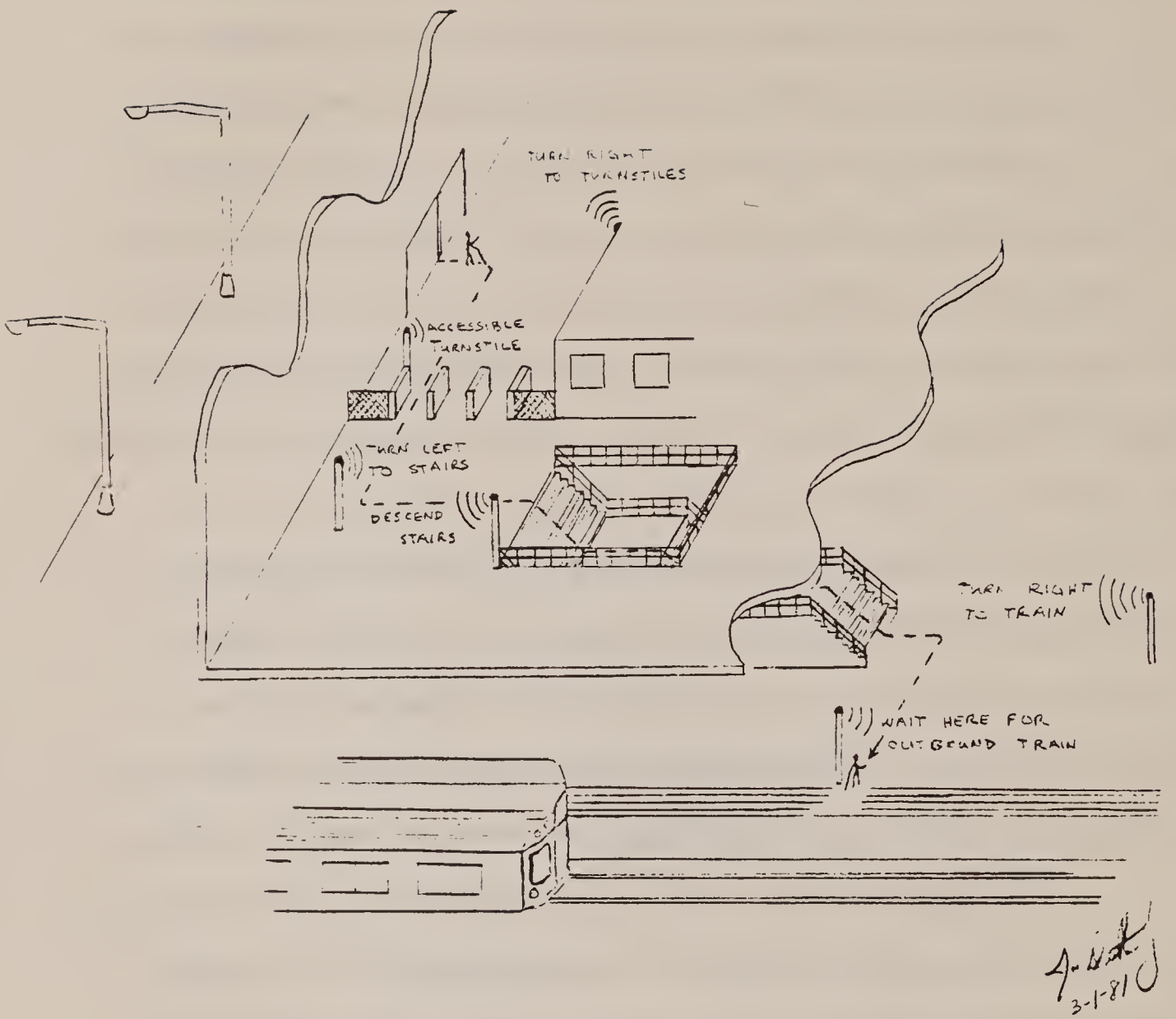


FIG. I-13. ARTIST'S CONCEPTION OF A REMOTE SPEAKER SYSTEM IN A RAPID RAIL STATION.

localization, 2) sound localization ability among blind subjects is quite good in the 500-900 Hz range (important because of the high potential for presbyacusis in the aged blind, which interferes more seriously in the 2 KHz and above frequency range), and 3) by using a single speaker, most blind subjects are able to use this sound source as a fairly accurate beacon. Poulsen's device automatically compensates for ambient noise and continuously produces a 900 Hz signal at a level 10-15 dB louder than ambient noise.

The use of Poulsen's auditory beacons in rail rapid transit environments would probably be restricted to entrances to stations and entrances to vehicles, since the tones would be continuously emitted 2000 msec. 900 Hz tone bursts with 200 msec. interstimulus intervals. A major advantage to this type of system is the fact that the user does not need to carry an activator. The signal is always present at a level where the user can identify and use it if he knows what it means.

The cost of these devices would vary depending on the availability of a power supply, the need to house the device in a weatherproof or vandal-proof package, and the intensity of the signal required by the ambient noise level. Nevertheless, the cost can be assumed to be relatively low and in the general range of a moderate-sized continuously-lighted neon sign.

Another possible application of Poulsen's research, however, would be to set up a series of remotely activated beacons similar to the Remote Speaker System described in paragraph F.2. and pictured

in Fig. I-13, and substitute approximately 900 Hz square waves at 15 dB signal/noise ratio intensity levels for the verbal messages. The two major advantages to such a system are 1) the cost of a square wave generator adequate for this purpose would probably be less than that of an intelligible verbal message generator, and 2) the tone could be ignored by sighted passengers who did not require assistance, whereas verbal messages might be regarded as noise pollutants.

The major disadvantage to this sytem, however, is that the blind traveller must be trained to use the system, which restricts the number of potential benefactors to those visually impaired persons who are trained by knowledgeable agencies to use the rapid rail system.

F.4. SONA (Sonic Orientation and Navigational Aid)

SONA is an electronic orientation aid which is currently being built by Gary Kelly, a Research Scientist at the Georgia Institute of Technology, under a grant from the Veterans' Administration. This device will utilize standard electronic-garage-door opener technology in combination with remotely located auditory beacons which can be individually accessed by pressing the appropriate code numbers on a hand-held touch-tone type keyboard.

SONA will be field tested in 1981, at the Atlanta V.A. hospital. The cost estimate for the prototype hand-held transmitter (5 in. x 2 1/2 in. x 2 in., 4 oz.) is $50.00. Each of the prototype receivers would cost about $40.00. According

PLEASE NOTE: This is a compilation of identified modifications. It is NOT a collection of recommendations.

to Kelly[15] costs can be expected to fall dramatically if the device is manufactured commercially in large quantities.

F.5. Protective Barrier

The purpose of this device would be actual prevention of falls from station platforms. The device would prevent individuals (handicapped and others) from falling, and might also serve to discourage impulsive suicidal leaps and injurious shoves.

Two designs for implementing this concept were presented in an earlier UMTA document.[33] Fig. I-14 depicts their image of a vertically retractable fence which rigidly prevents an individual from falling, and which itself retracts out of the way when vehicles arrive at the platform. Fig.I-15 depicts their image of a pivoting panel which serves the same purpose, but also acts as a bridge to the car floor once the train has stopped in the station.

An alternative to either of these devices would be a strong, light-weight curtain which, when drawn taught to a height of approximately 3 ft. would prevent falls, but which could easily fold out of the way at the platform edge once the train was stationary. Fig.I-16 depicts this device.

The cost of any of these devices is unknown, although it can be assumed that the curtain device (Fig.I-16)would probably be considerably less expensive than either of the other devices mentioned. Initial capital outlay would be comparatively small

(fabric, cable upon which it hangs, small radio-activated motor which operates pulley system, and pulley system). Maintenance would probably be less expensive because of the comparative simplicity of this lightweight system. The cost of retrofitting such a system would also be considerably less, since structural changes on existing platforms would be comparatively minor.

Evaluating a device such as that pictured in Fig. 16 should also be a relatively inexpensive project. A simulation could be prepared on a proposed manufacturer's premises to answer the two most important questions of reliability and strength of the system. Once it had been ascertained that the system would prevent falls and would operate reliably, larger scale on-site testing could be done in a busy station under various climatic conditions.

F.6. Warning Barrier

The purpose of this device would be the physical warning of any visually impaired traveller (including those who are untrained or poorly trained in the detection of more sophisticated tactile clues) that the platform edge had been reached. Essentially the device would be analagous to a curb at the edge of a street. A device which would accomplish this was recommended for another reason (i.e., bridging platform-car floor discontinuity)[33] and is pictured in Fig.

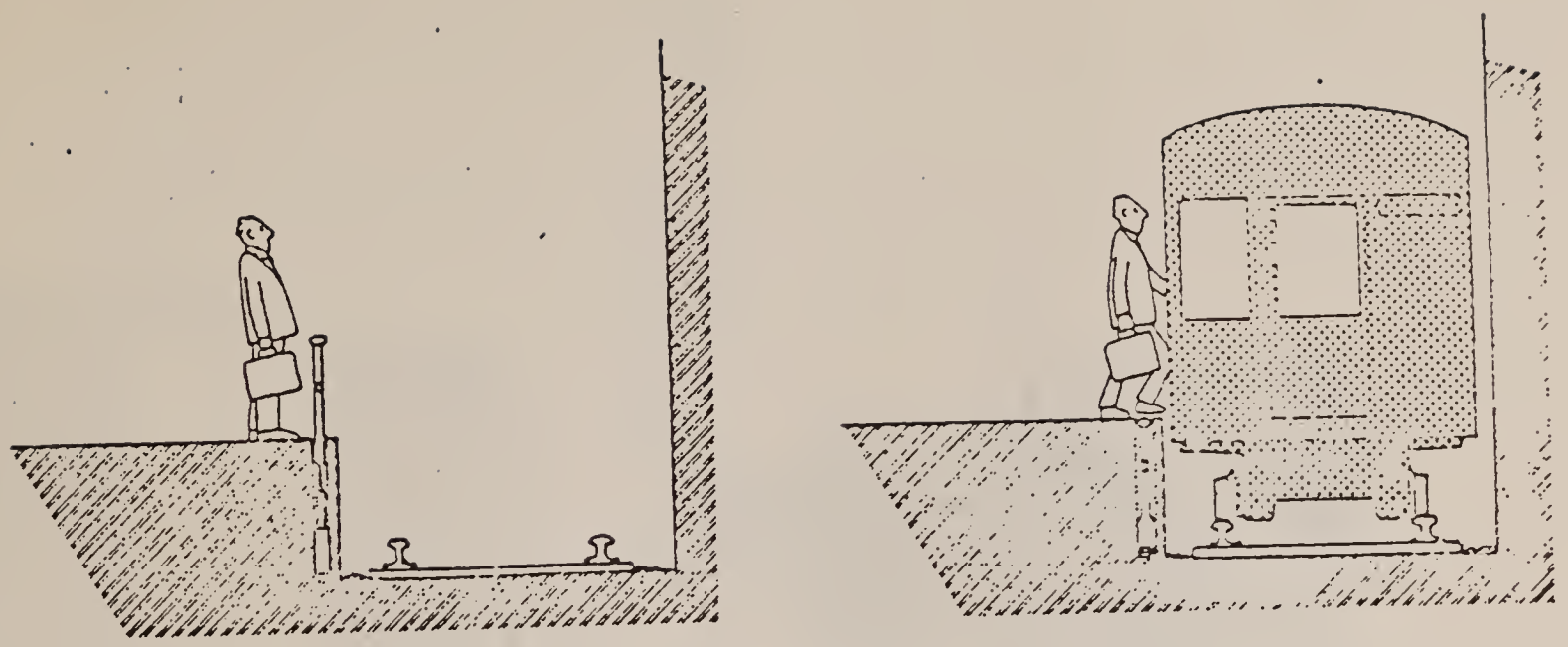


FIG. I-14. A FENCE-LIKE RAILING MIGHT RETRACT VERTICALLY INTO THE PLATFORM AFTER THE TRAINS PULLS IN.

From Crain and Associates (Eds.). Transportation problems of the transportation handicapped, vol. IV, Transportation solutions for the handicapped. DOT-UT-60063, August 1976.

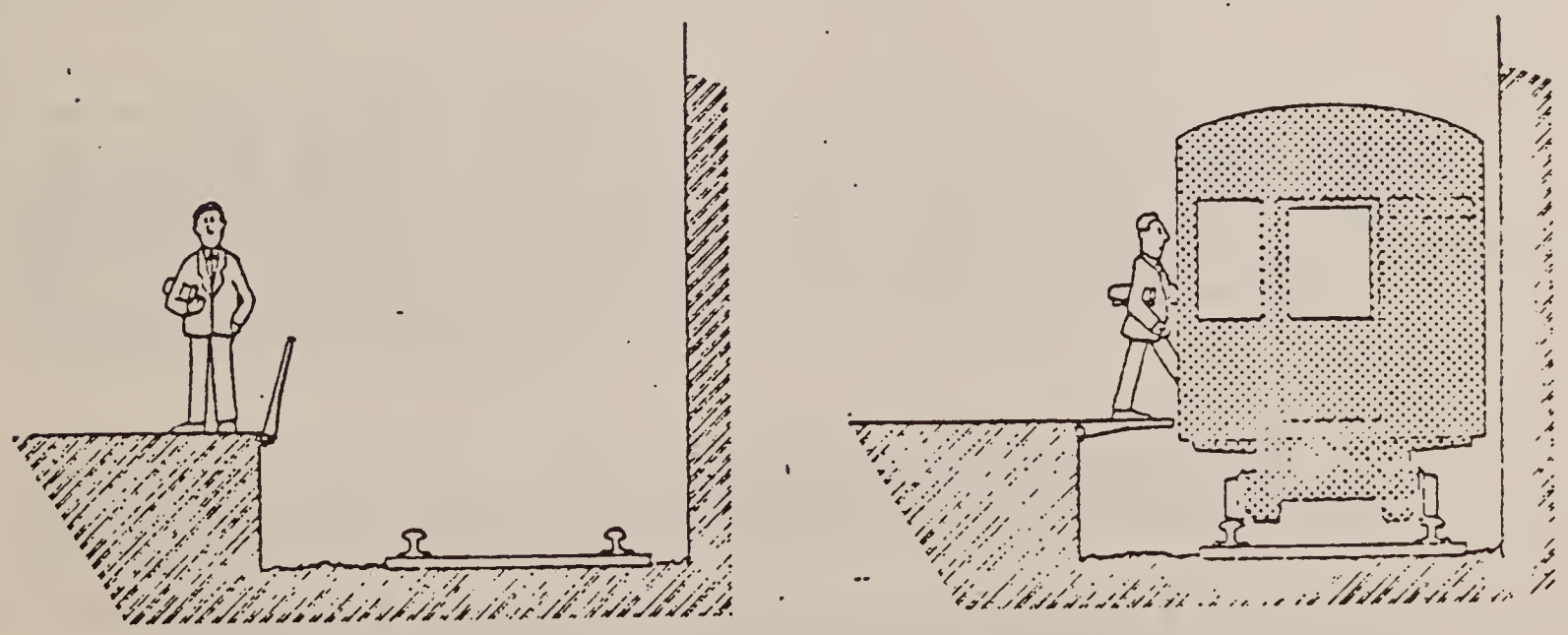


FIG. I-15. A PIVOTING PANEL ALONG THE FULL LENGTH OF THE PLATFORM EDGE COULD HINGE DOWN FROM ITS VERTICAL "BARRIER" POSITION TO BRIDGE TO THE CAR FLOOR, ONCE THE TRAIN IS STATIONARY. IT MIGHT ALSO ADJUST FOR UNEVENNESS IN FLOOR LEVELS.

From Crain and Associates, Ibid.

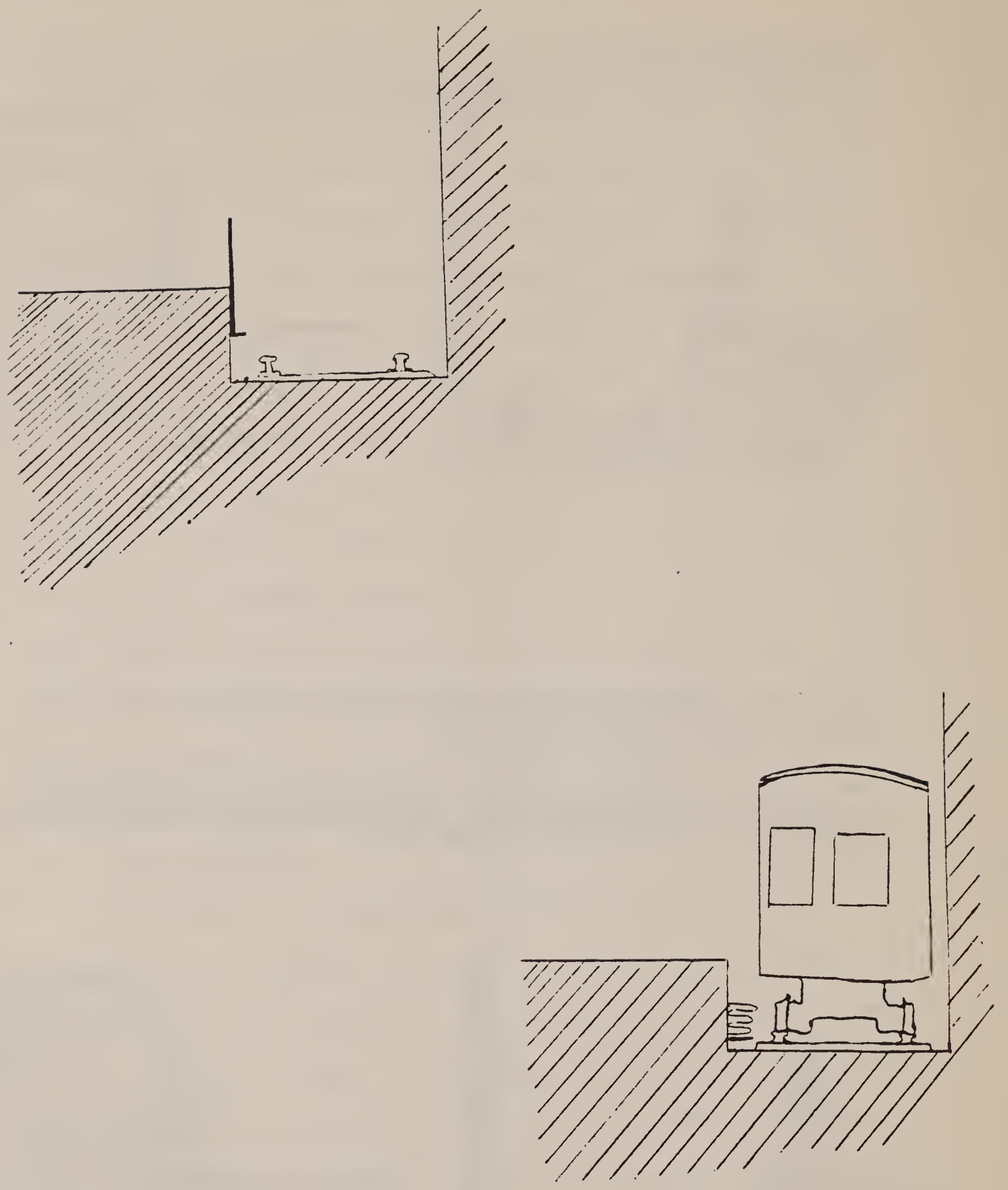


FIG. I-16. A CURTAIN WHICH, RAISED TO A HEIGHT OF 3 FEET AND LOWERED OFF THE EDGE OF THE PLATFORM, COULD PROVIDE A PROTECTIVE BARRIER.

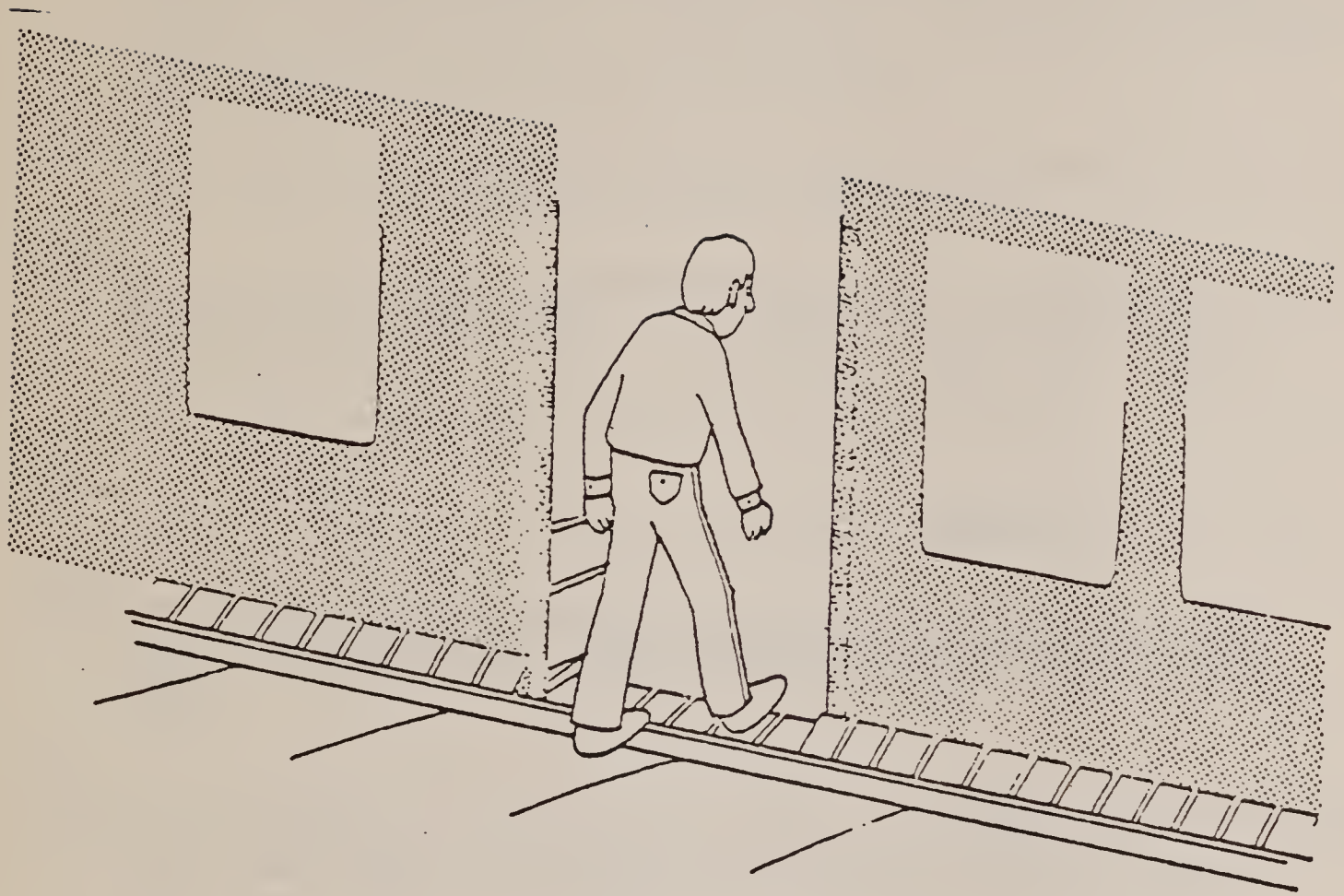


FIG. I-17. A SERIES OF SMALL (E.G., 4 INCH WIDE) FLAPS COULD BE ATTACHED TO EDGE OF PLATFORM. A CAM-LIKE ACTUATOR WOULD RAISE ALL OF THE FLAPS PRIOR TO THE TRAIN'S MOVING. WHEN THE TRAIN WAS STOPPED AND ALL DOORS OPEN, THE ACTUATOR WOULD LET THE RIGID FLAPS DROP. THOSE AT A DOOR OPENING WOULD BRIDGE THE GAP INTO THE CAR, THE OTHERS WOULD REST HARMLESSLY AGAINST THE SIDE OF THE CAR.

From Crain and Associates (Eds.) Transportation problems of the transportation handicapped, vol. IV, Transportation solutions for the handicapped. ODT-UT-60063, August 1976.

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